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AVIATION

The Oldest American Aeronautical Magazine

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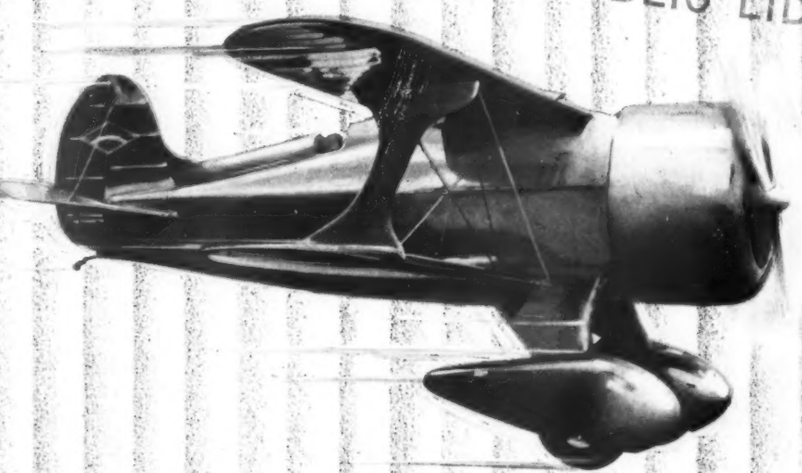

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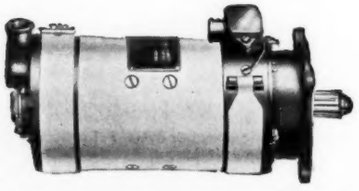

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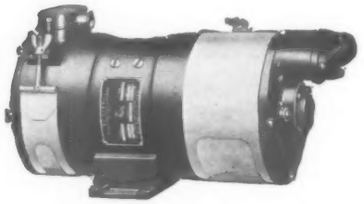

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AVIATION
A McGRAW-HILL PUBLICATION . . . EST. 1916

The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

LOUIS F. STOLL, *Publishing Director*

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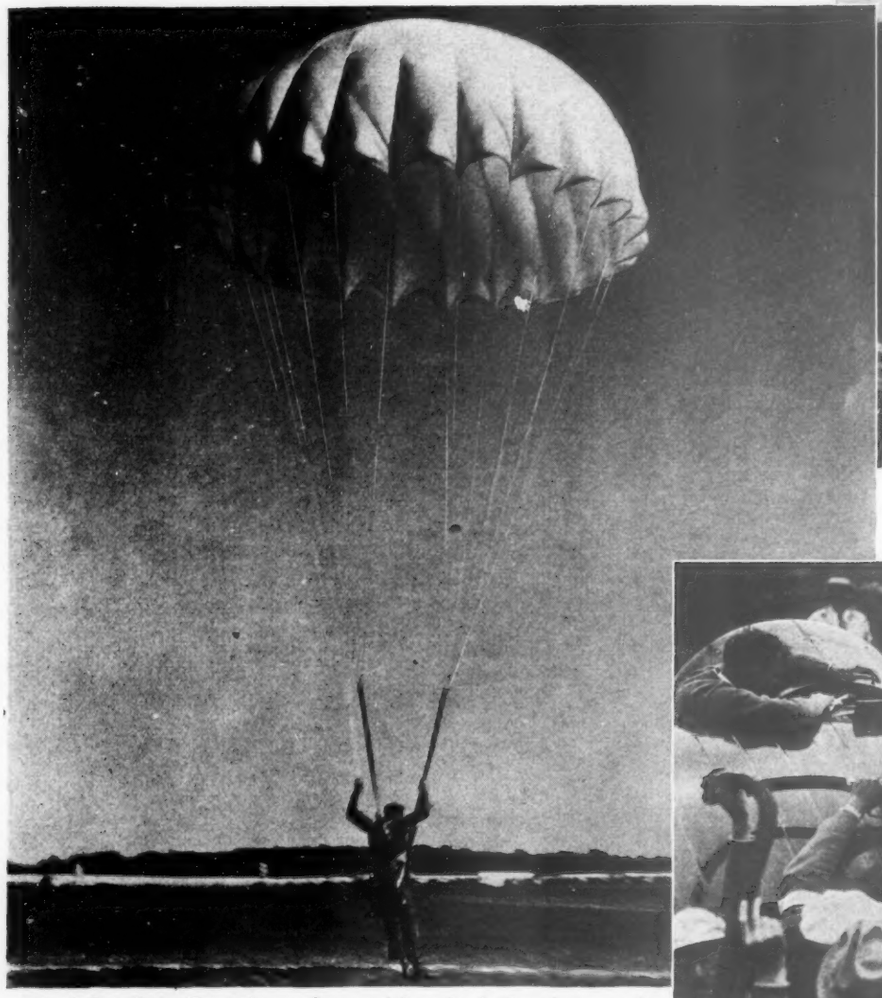

Com. R. L. R. Atcherley, R.A.F., prominent British aviator, "Irvin" equipped at the Cleveland contests.

(above) Don Roger Rae, winner of sweepstake prize in Parachute events at National Air Races, "hits the circle" with his Irvin Air Chute.
(at right) Major James H. Doolittle (and his "Irvin"), winner of Bendix Trophy Race, refueling at Cleveland, on his transcontinental record flight.

There Was Safety to LIFE - - - at the Races

Safety at all times - - and, in emergencies, 4 lives saved.

In the Air Derbies from coast to coast, as well as in the National Air Races themselves at Cleveland, increased confidence flew with the increased speed and performance that men and women pilots attained. This confidence was based not so much on the fact that IRVIN Air Chutes won 9 out of 10 firsts [as well as 6 seconds and 5 thirds] in the Parachute Exhibition events as it was that in actual service use these "Life Preservers of the Air" had actually saved over 500 lives - - and there at the Races, added 4 more to the grateful roles of the Caterpillar Club.

IRVING AIR CHUTE CO., Inc.
372 Pearl St., Buffalo, N.Y.
West Coast Factory and Office: 1500 Flower Street, Glendale, Calif. Canadian Factory: Bridgeburg, Ont.

IRVIN AIR CHUTES

"The Life-Preserver of the Air"

"Happy Landings", our motion picture on standard width film, showing IRVIN Air Chutes in action, is available free of charge to schools, clubs and organizations interested in aviation. Send for booklet and particulars.

1016

Wholly changing public opinion of AIR TRAVEL

A FULL REALIZATION of the potentialities of the Autogiro to the general public and the aviation industry can come only from actual knowledge of Autogiro flight.

Here is part of what Ben Ray Redman writes in a review of the book "Wings of Tomorrow" in the *New York Times*, June 28th, 1931:

"One morning last winter, standing on the Pitcairn aerodrome near Philadelphia, I watched James Ray take a flying machine into the air and make it do things that I knew no airplane could do. As he took off slowly, nose up and tail down, I knew he was going to crash; when he drifted over our heads at a speed of about twenty-five miles an hour, I felt a little sick, for a stall at that height was bound to be fatal; while he crawled around the turns, I looked away to avoid seeing him slip into a spin; and when he began to sink almost vertically towards the earth, I could only hope that an ambulance would be on the spot when he struck. But he neither stalled, spun nor crashed; and, as he settled lightly as a gull, with almost no forward speed at all, I found myself echoing the old protest: There ain't no such animal.

"I was wrong, of course. There is; and it is not, strictly speaking, an airplane. It is the Autogiro, invented by Juan de la Cierva, and it is the nearest thing to a fool-proof flying machine that has yet been built by man . . . Those long rotor-blades that you may have seen whirling in the sky, and that suggest a helicopter in their motion, are really driven by no power except that of the air itself; but as they turn, guided by air currents and obeying their own aerodynamic laws, they form a lifting surface that replaces the rigid wings of the ordinary airplane. They are, indeed, the "wings" of the Autogiro, for it is on them that this new machine flies, but they are free, flexible wings, quick to adapt themselves to the requirements of different speeds and different positions; and it is this new adaptability that makes the Autogiro safe, sound, and almost fool-proof . . . "

This expression of enthusiasm typifies the wholly changed attitude toward air travel that results from experience with the Autogiro.

The Autogiro Company of America is not a manufacturing or selling company. It is solely an engineering and licensing organization. It owns and controls, exclusively, all Autogiro patent rights in the United States. Manufacturing companies of high standing will be licensed to build Autogiros with the full cooperation of our engineering staff.

Present licensees are: Buhl Aircraft Company, Detroit, Mich. . . . Kellett Aircraft Corp., Philadelphia, Pa. . . . Pitcairn Aircraft, Inc., Willow Grove, Pa.

AUTOGIRO

Characteristics

The Autogiro differs basically from all other heavier-than-air craft in the source of its lifting capacity. This lift is given primarily by four rotating blades which take the place of the familiar wings of an airplane. There is no time when this supporting rotation of the blades can be stopped while the machine is in the air, as their motion is produced solely by wind pressure caused by the movement of the Autogiro in any direction, climbing, level flight, gliding or descending vertically. The supporting rotation of the blades is entirely independent of the engine, whose sole function is to propel the Autogiro.

The Autogiro presents flying characteristics hitherto impossible. It can take off at low speed after a very short run, and immediately assume a steep-climbing angle. It can fly well over 100 miles per hour or as slowly as 25 miles per hour. It can be brought momentarily to a standstill and hover. It can bank and turn slowly without fear of loss of forward speed. It can glide or descend vertically at a speed less than that of a man descending in a parachute, and with virtually no forward speed even with a dead engine. Above all, it cannot fall off into a spin from a stall. As a result, little operating skill is required.

AUTOGIRO COMPANY OF AMERICA ◂ ◂ ◂ LAND TITLE BUILDING ◂ ◂ ◂ PHILADELPHIA

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of SUMMERILL TUBING

Fast planes and daring stunts at the 1931 National Air Races marked the rapid advancement in aircraft engineering. Planes entered in the different races broke all previous speed records. Daring stunts that require the most accurate flying, dependable engines and sturdy ships thrilled thousands of spectators.

But back of all this speed and acrobatics—making these performances possible—was the tremendous strength of Steel tubing. Each piece of tubing in these planes must be of uniform strength—welded together into a structure that will easily withstand the terrific strain of such performances. That is why Summerill Seamless Steel Tubing is used in most of the planes you saw at the Air Races.

Summerill Tubes are made to rigid specifications and are uniform in strength. Inspection is under careful control. Back of all this is our thirty years of experience as tubing manufacturers —thirty years of making the finest quality tubing ranging from a delicate hypodermic needle to the minute accuracy of a rifle barrel.

And so with confidence we look forward to even greater aircraft performances, because we know Summerill Tubing will be the safe, dependable backbone on which these powerful engines will fly.

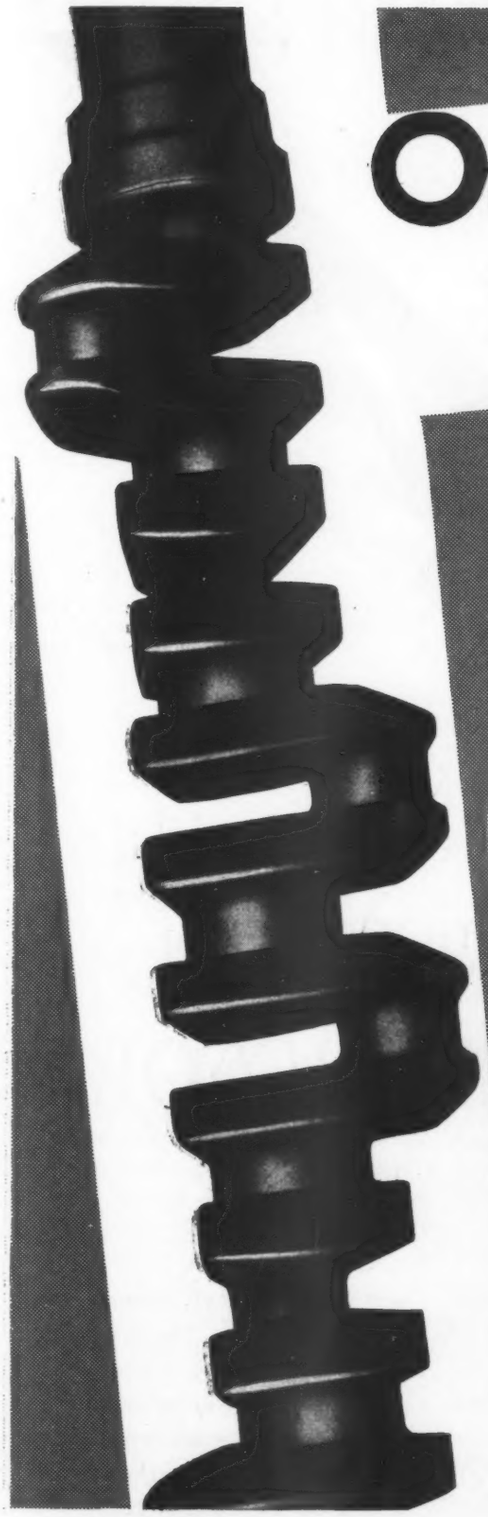
SUMMERILL TUBING COMPANY

BRIDGEPORT (PHILA. DIST.), PA.

THE STRENGTH OF THE PLANE IS SUMMERILL TUBING

TUBING by SUMMERILL

Since 1899



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as on the highways for the last 30 years!

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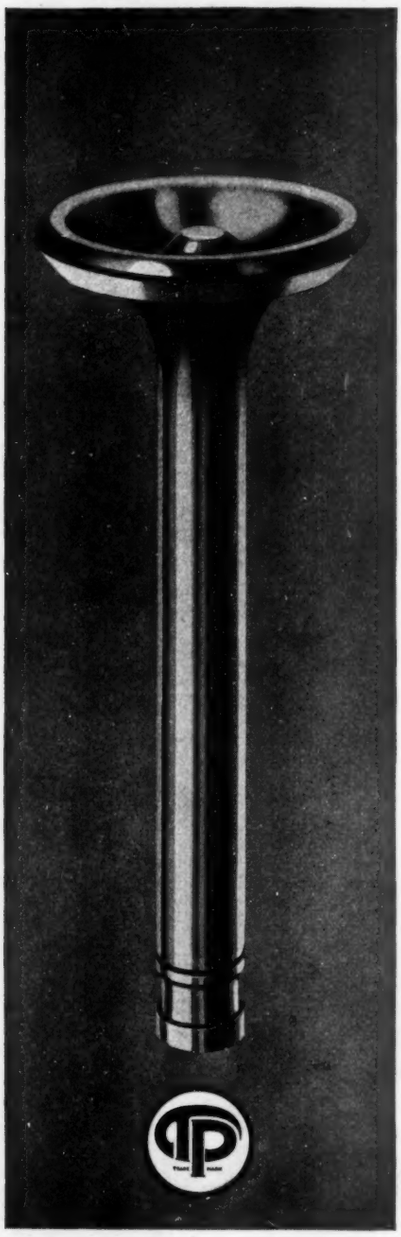

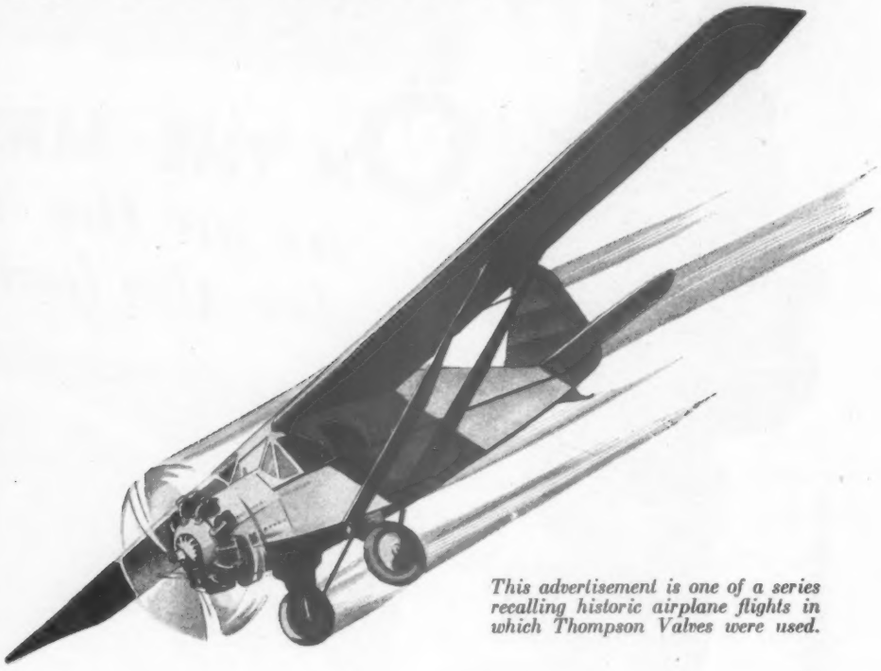

This advertisement is one of a series recalling historic airplane flights in which Thompson Valves were used.

BREAKING THE WORLD'S

NON-STOP DISTANCE RECORD

(New York to Constantinople)

CARRYING 728 gallons of gasoline, 25 gallons of oil, and two daring pilots, the Bellanca cabin monoplane "Cape Cod" fought her way into the air against 7500 pounds of weight at Floyd Bennett Airport, New York, on July 28th last. Forty-nine hours and eighteen minutes elapsed. The enormous gasoline supply was consumed to the last drop. But by that time the minarets of Turkey's ancient capital lay beneath the ship, and a safe landing was made at Yechilkey Airdrome, Istambul — 4,999 miles away.

This record-breaking flight—among the greatest in its appeal to the imagination and the thoroughness of its accomplishments — was made possible by the dependable performance of the "Cape Cod's" 300-hp. Wright Whirlwind motor. A vital factor in this performance was the valves—which were furnished by Thompson Products, Incorporated.

THOMPSON PRODUCTS, INC.
General Offices: Cleveland, Ohio, U. S. A.
Factories: CLEVELAND and DETROIT

Thompson Valves

AVIATION
A McGRAW-HILL PUBLICATION . . . EST. 1916

The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

VOLUME 30 . . *October, 1931* . . NUMBER 10

Looking toward the Budget

FOR any government, as for an intelligently managed business, a budget plan is a necessity. Only the United States among great civilized nations managed for many years to get along without one. Only our great and rapidly growing national wealth made it possible for us to pursue such an inherently extragavant course, with complete lack of executive control over new projects for spending money. In 1921 we turned our back upon the old ways, and since then the Bureau of the Budget, nominally the instrument of the President's personal financial will but actually more or less an autonomous body under the guidance of its Director, has played a great part in Washington as some budgeting authority does in every foreign capitol.

The Bureau of the Budget works in silence, almost in secrecy, and it is easy to underestimate its sway. Its power is immense. It is the almost invariable practice for Congress to take the budget estimates as basic, making frequent minor cuts and a few very small increases, but finally turning in appropriation bills which differ only in detail from the layout submitted in a bulky volume accompanying the Presidential message on the day following the opening of the session. *If the aircraft industry recognizes that there is likely to be, as almost every statement on financial topics now coming forth from Washington would suggest, a substantial cut in the allotment for the purchase of new airplanes and a substantial addition to unemployment in the aircraft industry in the name of government economy, the time for it to make its voice heard is now. We should not delay until the news of the Bureau's definite decision, as ratified by the President, is set up on the bulletin boards.*

Most citizens have only the vaguest idea of what the Budget does or how it does it, but even though it be shrouded with the aura of mystery it is a human organization subject to human limitations. It must depend, in laying out its work and reaching its conclusions, on the same processes as any other individual or organization would employ. To wit, it must get its information on what is going on and what is likely to happen in future by inquiring at the source.

In most cases inquiring at the source means inquiring from the government department most directly concerned. When the Director of the Budget and his assistants seek to find out how much money they should allot for carrying on the foreign service of the United States they turn to the State Department, as the only available authority upon the magnitude of the work in hand and its probable cost. The same is true of appropriations for the support of agriculture, or the Coast Guard, or the Patent Office. Inquiry from government officials is ordinarily sufficient, and the budgetary

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authorities ordinarily confine themselves to such inquiry, but in considering the appropriations to be made for aeronautical activities, especially for the purchase of aircraft for military and naval use, the interested government departments alone are not in the position to tell the full story.

There is another vital interest outside their immediate scope—that of the aircraft industry. The industry's development and status have long been recognized as matters of national concern. They constitute an essential part of the material to be considered by the Director of the Budget in preparing his statement for the coming fiscal year for the consideration of the President and transmission to Congress. The government cannot afford to let the industry decline too far. Its position, and its opinions, cannot be adequately or properly represented by military and naval personnel alone. The Budget Bureau's practice of holding its meetings behind closed doors, with witnesses of its own selection and chosen only from the government employ, may assume elsewhere the aspect of an orderly procedure kept free from public clamor and from political influence, but it becomes here, in application to the present aeronautical problem, a star-chamber proceeding in which a great industry built up largely in response to government demand stands in danger of being condemned unheard—in contravention of the very fundamentals of justice.

Manufacturers are concerned, and properly so, about the effect of the coming appropriation bills upon the stability of their business and upon their capacity to keep intact at least the nucleus of carefully-trained organizations. *It is not too much to say that the very fate of the American aircraft industry, as we have come to know it in the past three years, and its future usefulness as a national asset hang upon governmental action with respect to the appropriation bills for next year. That fate will be most largely decided not when the appropriation bills reach the headlines and become the subject of Congressional oratory, but between Oct. 1 and Nov. 15 in a plainly furnished office at the end of a long corridor in the Treasury building.*

The path of the industry is plain and straightforward, if the government authorities will give it a proper opportunity to speak in its own defense. There is no occasion for any such detective-story maneuvers as the writers of political novels love to describe. The industry needs no professional lobbyist to provide lavish entertainment for Congressmen and blanket the Washington scene with guile. Such gentry are usually much more successful in hoodwinking their employers than in affecting legislation. The course for us is much simpler and much more effective. The aircraft industry requires only representation by its own leaders.

In the days when it was the fashion to have a new investigation of the aircraft industry every spring and every fall, men who were active in the industry and who knew its problems at first hand were given their day in court. The names of Keys, Lawrance, Martin, Loening, Vought, and P. G. Johnson are on the record among the witnesses. They testified, and they were cross-examined. It was a good practice. *Let us hope that the high officials of aircraft manufacturing companies and air transport lines will again be invited to appear in Washington and lay their cards upon the table. Let us hope, and express it in the form of an earnest plea to those who have the power to issue such an invitation, that the industry's leaders may go before the Bureau of the Budget at its hearings, where the press is barred, and where no record is kept for subsequent publication, and where no lobbyist has the chance of penetrating. To Col. J. C. Roop, Director of the Budget, we address a solemn reminder that he, more than any other man except the President himself, has the immediate power of determining the future health of the airplane industry and its strength as a national asset. To Colonel Roop we put the direct question: Will you give the men who have shaped the industry, and who are best able to understand and portray the effect of any changes in its relation with the government, the chance to tell their story at your hearings?*

Flying the mail for twenty years

IN THE midst of the preparations to send this issue of AVIATION to press, there occurs an anniversary of one of the two or three greatest events in the history of air transport. Exactly twenty years ago, on Sept. 23, 1911, Earle L. Ovington flew his monoplane from Nassau Boulevard to Mineola on Long Island, a distance of five miles, and carried a sack of mail with which he bombed the postmaster who was waiting at the far end of the route to receive it.

The historians may argue over whether or not that was the first airplane mail experiment. Similar ventures were tried as spectacular additions to aviation routes in the various European countries. In any case it was not literally the first aerial delivery. For that one must go to the Ballon-Poste which kept beleaguered Paris in touch with the outside world during the war of 1870. But nevertheless the Ovington flight was a pace-maker for the world, for the United States postal authorities have led those of all other nations in following up the experiment and putting it into practical commercial use.

It was the first faint and almost frivolous beginning of a service which has built up a tradition excelled by none in the world. Tradition has grown and remained ever untarnished in the keeping of that dauntless band, the air mail pilots of the United States,—from Earle Ovington to the newest recruit,—some famed and others unsung,—many still in the service and many dead in line of duty,—the couriers whom neither wind, nor rain

and snow, nor gloom of night has stayed from the completion of their allotted task.

A long succession of postal officials have shown extraordinary vision, especially in the very earliest days, in recognizing the airplane as an instrument of postal transport. The general nature and immense scope of its services was forecast by the Postmaster-General at the time of the 1911 venture, and again by his successor in the Wilson administration. What they saw from twelve to twenty years ago has been but slowly appreciated elsewhere, and it is only very recently that air mail has been universally recognized as one of the brightest stars on the aeronautical horizon. In Europe it has been an incident, and a minor one, of air transport, and only within the last few months have new specifications been issued for new planes especially for postal service. In the United States it has been the cornerstone of the building and the keystone of the arch, and in 1930, 75 per cent of the gross income of all the airlines in the United States came from the carriage of air mail matter.

We have often been exceedingly critical of the details of the policies of the Post Office Department and of the way in which the air mail service was being administered at the moment. No doubt we shall be critical again from time to time. That very fact makes us all the more eager to acknowledge the positively inestimable debt that American aviation owes to the Post Office, and especially to the distinguished line of far seeing men who have served as Postmaster-General, Hitchcock, Burleson, Hayes, New, and Brown, and to their right bowers in moving the mail, Praeger, Shaughnessy, Henderson, and Glover.

Financial depressions and airport development

ALMOST all of the innumerable panaceas for depression that have been launched in the past year have had the common thought that it is better to subsidize work than to subsidize idleness, and that it is both socially and economically sounder to provide men with jobs than to pay them for not having them. Specifically, one of the most obvious measures of relief is through the expansion of public works. It is a measure that has particularly commended itself to the administration, and the President has never lost an occasion for explaining the federal government's endeavors to improve unemployment conditions through accelerating its building construction. The public works programs as now being applied are subject to certain limitations in scope and usefulness. Aviation can, at least in part, remove those limitations.

The amount that can be wisely spent on public buildings is limited by the need for new construction. The rapidity with which the public works cure can be applied is limited by delays for planning, for developing the plans for a new building and getting ready to let the contracts is at best a slow process.

But there is at least one type of public construction to which those disadvantages scarcely apply. The need for airports is still great. There are many areas which should have fields and for which no provision has yet been made. There are many airports which are still but little advanced from the vacant lot stage and which are urgently in need of grading, hard-surfacing of runways, provision of new buildings, and the like. It is conservative to say that 80 million dollars could and should be put into airport development, without economic waste and without the expenditure of a nickel where it will not be rendering a real service to aerial transportation, and it can all be done without serious delay.

One of the virtues of airport work in the present emergency is that most of it requires no long consideration or elaborate plans. Surfacing work need wait only upon an engineering survey of the ground to be treated. Buildings can be largely of standardized type, and can be contracted for without long architectural preliminaries. Eighty million dollars worth of work, or thereabouts, wait only upon the spur to act and the assurance that there will be money with which to pay the bills.

The first wave of enthusiasm for municipal airport construction subsided in 1928. To arouse new municipal activity there must be some new incentive. Local enthusiasm must be backed up by the pressure of the general interest in an improved national airport network.

There is an obvious way of developing such an incentive, and also of insuring that the municipalities which have depleted their credit will have money to go ahead with needed work. Both can be accomplished through a system of state and federal aid. There are many cities which are today in such desperate financial situation that they are quite unable to take care of all their relief problems without external assistance. Assistance may be given in providing food and shelter for the unemployed, as many states are now preparing to give it, or it may be given in providing productive work, which is far better. The credit of cities is on the whole weak. That of the states is much stronger, and that of the federal government is entirely unimpaired. In one way or another the strong are obliged to aid the weak. They can hardly do so more effectively than through measures which will at the same time provide relief for the needy and lay the foundation for further extensions of the air transport map, and for a more general use of aircraft. The municipality which undertakes airport work at the present time is rendering direct and indirect service to all its citizens and a double service to some of them, jobs in the present and a public utility for their future

enjoyment. State and federal governments, in coming to the support of a municipality in such work, will be alleviating immediate distress among their people and also increasing the value of all existing air navigation facilities—for the usefulness of any aid to air navigation is proportioned to the number of possible routes that it serves, or to the number of places to which one is able to fly with safety and comfort.

All this may seem vague. It brings up a very specific proposal. The principle of federal aid to the states on highway construction is well established. Federal expenditures in that field in the last three years have totaled 433 million dollars, and for the present year alone are 235 millions. All that is required to make airport work available in the present crisis is the application of the same method there.

It should be not only applied but extended. The place of the states in highway construction has been recognized so long and so clearly as to be beyond argument. Their place in airport construction is not yet established. In accelerating the development of ground facilities for aircraft there should be three links in the chain instead of two.

The federal government should be prepared to come to the aid of the states by sharing, on the basis of approximate equality, whatever expenditures they may have incurred either for direct construction of state airports or for assistance to municipalities. The states should similarly offer financial assistance to the municipalities constructing new fields or improving the condition of an existing one, the assistance again taking the form of a direct contribution of a fixed proportion of the cost. Under ordinary conditions the share of the state might be a very small one, designed merely to furnish a stimulus to new work which would not be undertaken by municipal governments unless some sort of a bonus were dangled before their eyes. In the present emergency it should go further. The proportion might well be as high as 50 per cent, with the final result that one-fourth of the expense would be borne by the federal government, one-fourth by the state, and one-half by the municipality. All such works will of course be subject to initial approval by federal and state governments, to make certain that they would serve some economic function and form a proper part of a co-ordinated state-wide and nation-wide system, and subject to continued technical supervision by federal and state authorities to guard against waste.

This is a notable departure from past practices of the federal government in its dealings with air navigation, but it is a departure for which, as we have shown, there is ample precedent in other fields. It seems to us a very modest proposal, and one that can be supported upon both economic and social grounds in the face of the sternest criticism. We respectfully present it for the consideration of Congress and of state legislatures, and we urge upon our readers that they make it their personal interest to bring it to the attention of their own representatives at Washington and at their state capitol.

The lightning strikes

THE President's recent expression of indignation because the noise of three aircraft disturbed the ceremonies at the Harding Memorial made the front page in newspapers throughout the country. The executive wrath strikes at the heart of one of aviation's most vital problems. Like a bolt of lightning it should serve to warn the industry that storm clouds are hovering; in this case the gathering clouds of aroused public indignation.

There are many evidences of growing impatience with the nuisance caused by airplane noise. It is reported that one hundred and fifteen residents of the city of New York wrote to the noise abatement commission during 1930 complaining about the noise of aircraft. It is probably safe to estimate that at least a hundred times as many people were just as incensed but did not trouble to write about it. Farmers are demanding changes in established air routes because the noise of transport planes makes hogs lose weight and hens stop laying. Other instances can be cited almost without number.

Even if the grievances of those upon the ground be neglected, thousands of members of the general public are sitting in the very midst of this objectionable racket every day, riding around with it from place to place over our established air transport lines. Like their shadow, the noise is always with them. Many thousands of patrons are being won to the airlines in spite of the noise, but none of them like it. How long will they stand it?

The noise must go! It must go from the airplane as public opinion forced it out of the automobile. It cannot be tolerated. That it will eventually be eliminated is conceded by everyone. It had better be started now. We have been entirely too complacent in our attitude toward a nuisance which the public should not, and in the long run will not, stand for. President Hoover's action is a warning that the industry must clean house on the acoustic problem without delay.

A great volume of uncorrelated data on the subject already exists. Concerted effort on the part of aviation executives and engineers will make much of this information applicable without any further research. Further study, and active cooperation with specialists in the field of acoustics, will speed the day of the reasonably quiet airplane. It is possible at the present time to reduce the noise of the engine exhaust by 80 per cent without any serious effect on back pressure and with but little increase in weight. The propeller presents a more difficult problem, but it is by no means inherently incapable of solution.

News of the Month

Racing in the spotlight

THOUGH the National Air Races were flown over Cleveland, the opening contest was flagged off from Santa Monica, Cal., whence 52 fliers started off on a handicap sweepstake air derby to the eastern airport where the racing proper was to be held. The grand prize for the derby, which wound up with the flurry of discontent and claims of fraud which often mark handicap events, as well as that for the women's division, went to Mrs. Phoebe Omlie.

California also saw the take-off of the transcontinental race for the Bendix Trophy, which Maj. James Doolittle captured in the course of his coast-to-coast flight of 11 hours, 16 min. and 10 sec., an hour and almost nine minutes better than the previous record set by Capt. Frank Hawks. Doolittle's plane, built by E. M. Laird, designer of the plane flown to victory in the Thompson Trophy race last year, was forced to yield place in the classic and final speed event this year to a Gee Bee flown by Lowell H. Bayles of Springfield, Mass. Taking off in second place, Bayles soon overtook the leader, to finish the 100-mile race in 25 min., 23.88 sec., an average speed of 236.239 m.p.h. from a standing start. An overheated engine forced Doolittle to drop out in the seventh lap, after flying in second place for the first 50 miles. J. R. Wedell flew a Wedell-Williams plane to second place, averaging 227.992 m.p.h., or 26 min., 19 sec. for the course. Doolittle, Bayles, and Wedell all used supercharged Wasp Juniors for power. A Whirlwind-powered Laird plane built for Lee Schoenhair, but flown by Dale Jackson, took third place, with an average speed of 211.183 miles, after hitting a tree and damaging the wings, half way through. Jackson slowed down about 20 m.p.h. after that contretemps but kept on to the finish.

Another Schneider passes

The Schneider Trophy was secured permanently for Great Britain whose high speed flyers had already won it twice in succession, by Lieut. J. N. Boothman who flew a Supermarine S.6B seaplane seven times over the 31-mile course at Calshot at an average speed of 340.08 m.p.h., more than 11 m.p.h. faster than the speed which the late Lieut. H. R. B. Waghorn travelled to win the 1929 event. With the competitive element removed by the last-minute withdrawal of the French and Italian teams, the culminating disappointment of a training period haunted by accident, public interest lay solely in the breaking of previous records. The first two laps of Boothman's flight served to set a new record for 100 km. (62.1 miles) with a speed of 342.9 m.p.h. in place of the previous mark of 331.75 m.p.h. In a second S.6B Lieut. G. H. Stainforth set a new world speed record over a three kilometer course when he averaged 379.05 m.p.h. for four laps, bettering the record established by Squadron Leader A. H. Orlebar in 1929 by more than 21 miles.

The S.6B Rolls-Royce powered Supermarine monoplanes responsible for the three-fold triumph differ little in appearance from the winners of the 1929 contest, but embody several striking improvements. Most important is the greater power of the engines which produce about 20 per cent more than the 1800 hp. made by the earlier models. The water-cooling system which occupied about 85 per cent of the wing area of the 1929 racers in the new S.6B utilizes the entire upper and lower surfaces of the wings and the upper surfaces of the floats to provide sufficient radiator surface to allow the plane to be flown with the engine at full throttle, impossible previously. The floats of the new racers are not only larger, to provide a greater fuel capacity, but of a design which reduces air resistance and gives additional lift. Static balances on the hinges of the ailerons and rudder tend to eliminate flutter. With a specially supercharged engine which is to be installed in one of the Supermarine racers shortly it is expected that it will be capable of even greater speeds than those made with a standard racing engine.

Germans race in tour

Although considerably embarrassed by the German financial crisis, the Aero Club von Deutschland refused to allow postponement of the Deutschlandflug, or German air tour. Technical tests for take-off and landing, folding and portability, slow flying, fuel-consumption and load-carrying were held in advance of the two-day tour which was flown from Staaken to Munich (725 m.), with four intermediate landings, on the first day, and via Vienna and Breslau, back to Berlin on the second, a total distance of 1,358 miles. Nineteen competitors left the Berlin-Staaken airport on Aug. 15, and fifteen, with Lieutenant Dinort at their head return to Berlin-Tempelhof the next day. Dinort's winner's average speed was 102 m.p.h. Flying the only plane in the light plane class, weighing less than 700 lb., Wolf Hirth who was a feature performer at the Elmira Glider Meet in 1930 and subsequently soared for an hour over Riverside Drive in New York City, took second place at 91 m.p.h.

Calendar

Oct. 3-4	Second British Gliding Competition at Baldsdean, Sussex.
Oct. 8-11	All Southern Aircraft Pageant, Charlotte, N. C.
Oct. 15	National Safety Concil, Meeting of Aeronautical Section, Chicago

The Do.X does it

Landing in New York harbor on Aug. 27, the Dornier Do.X completed a project begun the fourth of last November, when it left Friedrichshafen for Amsterdam and Calshot, England, the first lap of a flight to the United States. A mysterious wing fire occurring in Lisbon and the combination of revolution and tropical humidity and lack of wind each accounted for months of delay, before the hop from the Cape Verde Island to Brazil was made, early in June. City to city hops up the length of South and North America have been the program since then, the passenger list on the last of these, from Norfolk to New York, numbering 70 persons. Thus loaded, a weight of more than 50 tons was sustained by the twelve Curtiss Conqueror engines and carried a distance of over 300 miles in 3 hours and 15 min. Future plans are indefinite, but any reasonable bid for the plane by transport organizations in this country would be received with interest.

Not many days after the Do.X had been moored at Glenn Curtiss Airport, at North Beach, Capt. Wolfgang von Gronau set down its miniature, the twin-engined Groenland-Wal, on the water close by. With the same plane and crew which crossed the Atlantic with him a year ago, Captain von Gronau recently flew from Westerland, Germany, to Chicago, by way of Iceland, Greenland, Labrador and Canada, to collect data for the establishment of mail routes through the sub-Arctic regions. Seven

stops were made over a route similar to one followed so disastrously by Parker Cramer a month ago.

Also following the trail of Cramer and Paquette are Edwin Preston and Robert Collignon, in the second plane to be sent out by the Transamerican Airlines to survey air routes to Europe. Stops were made at Goderich and Sudbury, Ontario and at Rupert House and Port Harrison on Hudson Bay, where non-appearance of an expected boatload of fuel is detaining them indefinitely.

Dense forgs, forced landings on remote islands, and the treacherous weather of the north Pacific are merely memories to Colonel and Mrs. Lindbergh, who were received in Toyko on Aug. 26 with triumphal marches and other demonstrations of popular enthusiasm. Their vacation flight had been made across 7,830 miles of northern Canada, Alaska, the Behring Sea, the east coast of Siberia, and the northermost islands of Japan, in 86 hours flying time. The only difficulty with their Cyclone engine developed when fog, forcing a landing off one of the remote islands of the Kurile group resulted in a wet spark plug and rough water prevented its being cleaned until a more sheltered spot was reached.

Some new records

So long as Capt. Frank Hawks and James Hall continue to fly, inter-city records continue to fall. En route to South Dakota to receive honors from the Sioux Indians Captain Hawks clipped six minutes from the existing New York-Chicago record, making the trip in 4 hours 6 min. from Roosevelt Field. Returning the next day, bearing a new name, Chief Flying Hawk improved on his own time by twenty minutes. Captain Hall established a New York-New Orleans record, flying the 1,184 miles non-stop with a passenger in 7 hours 14 min.

Several other records than those made in connection with the Schneider event have been established recently, two in the light plane class. The new speed for light planes of the second category, under 280 kg. is 111.8 m.p.h. made in Poland by an R.W.D. plane powered with a Genet engine, exceeding the previous time of a Farman 230 by 7.8 miles. France is also in the process of losing an altitude record for single seaters of less than 200 kg. empty weight, which was taken by a Heath Parasol whose baragraph as checked by the U. S. Bureau of Standards was read at 17,907 ft., 872 ft. above the previous figure. However, France claims one new speed record, that for seaplanes with a two-ton load. Naval Lieutenant Demougeot and Pilot Gonord maintained an average speed of 102.5 m.p.h. over a distance of 1,242 miles.

To further the interests of the French aeronautical industry a group of six French military planes, were flown on an extensive tour of Europe by famous "Aces" of the fifth arm of the service. Under the command of Gen. de Goys de Mezeirac, who was piloted by Captain Costes, four all-metal Brequet planes and two Potez scouting machines visited Brussels, Copenhagen, Oslo, Stockholm, Riga, Warsaw, Bucharest, Constantinople, Rome and other cities of importance, returning to France about the middle of August.

The attention of aeronautical circles in Italy has been centered on a session of Army Air Maneuvers including an even larger number of aircraft than those held over the eastern part of the United States this past spring. The armada of 894 planes was divided into a defensive force and an offensive group, the latter so effective in its attack on mercantile and industrial centers and lines of communication that it rendered the cities of northern Italy practically "helpless." As a finale to the meet, the entire force, which included 288 land fighters, 48 sea fighters, 48 land attack planes, 120 night bombers, 128 day bombers, 76 naval bombers, 13 bombers of experimental types, 20 planes for reconnoisance, and 152 reserve aircraft of various types, passed in review at Ferrara.

Perhaps bearing in mind the recent ineffectual attempts of army airplanes to sink the target Mount Shasta, the Navy has announced that in its experiments to be conducted on the obsolete cruiser Pittsburgh only dummy bombs will be used since it has no intention of sinking the cruiser. The tests will take place in Chesapeake Bay, under the supervision of a board of naval officers and observers will be limited to officers of the Army and Navy, no public report being made of the results.

With the opening of the new Air Corps Training Center at Randolph Field, near San Antonio, Tex., Brooks Field and March Field at Riverside, Cal., will cease to function as such. The entire new class of primary flying students will be handled at the new school, the other fields being reserved for new organizations created under the Five-Year Expansion Program.

Acme

AMATEURS RACE TO CLEVELAND

Planes on the line at Aviation Country Club, Hicksville, L. I., N. Y., awaiting take-off of first annual handicap race under auspices of the Amateur Air Pilots Association for the Charles L. Lawrance trophy.

Services buy more equipment

Contracts for new Air Corps equipment, 71 planes and 92 engines, were recently approved by the Assistant Secretary of War, at a total expenditure of $2,571,757.77. The Douglas Aircraft Company is to supply six observation planes, distinct from previous models in that they are high-wing monoplanes instead of biplanes each costing about $21,000, and eight amphibions with spare parts and equipment, similar to the commercial product announced at last April's Detroit Show, at a unit cost just under $20,000, the total for fourteen planes with spares being $358,784. Four transport planes, powered with Wright Cyclone engines and complete with spares have been ordered from the American Airplane and Engine Corporation at $17,300 each. Under a $704,629.33 contract the Curtiss Aeroplane and Motor Company is starting production of 46 pursuit planes, spare parts and equipment, the price per plane being $12,300. These planes are to be powered with Curtiss-type V-1570-C engines of approximately 700 hp., 92 of which have been ordered from the Wright Aeronautical Corporation at a cost of $6,300 each, the total contract of $726,540 including the necessary spare parts.

The Boeing Airplane Company of Seattle is working on orders for both the Army and the Navy. The Army Air Corps has contracted for seven bombardment planes reputed, like those recently delivered by the Boeing company, to have remarkable high-speed characteristics. Each plane will cost nearly $80,000 and is to be equipped

with either two air-cooled P & W Hornets or two geared liquid-cooled Curtiss G1V-1570 engines. The Navy has ordered 45 single-seater fighting planes with spares, powered with P & W Wasp engines and costing $9,400 each, for use aboard aircraft carriers of the fleet.

Both branches of the service are in the market for other aeronautical equipment. The Army Air Corps has just awarded to the Switlik Parachute & Equipment Company a contract for 1,283 parachutes. The Navy Department has let a contract for 184 propeller blades to Hamilton Standard.

British flying boats on tour

Two new British long-range flying boats, a Short Singapore II powered with four Rolls-Royce Kestrel engines of 480 hp. each, making them the fastest flying boats in the world, and a Saunders-Roe A7 with three Bristol Jupiter 500 hp. engines, are making a test flight from England over the Mediterranean and the Red Sea, to determine which is better fitted for coastal reconnaissance and long distance sea patrol with the Royal Air Force. Before an order is placed by the R.A.F. the sample plane must establish its superiority over a route which includes Bordeaux, Marseilles and Malta to Aboukir, whence a return flight is planned with only two stops at the British stations of Malta and Gibraltar.

Alan Eustis of New York City won the Charles L. Lawrence Trophy for the best score in the sealed handicap cruise staged by the U. S. Amateur Air Pilots Association Sept. 4-5. The cruise started from the Aviation Country Club, Hicksville, L. I., with twelve machines participating, and ended at the Cleveland Municipal Airport as an item of the National Air Races. Handicaps were based on average speed demonstrated by each plane over a measured course. The handicaps were not announced until the arrival at Cleveland, each pilot maintaining the best average speed possible during the cruise. Mr. Eustis' average speed was 98 per cent of the handicap figure. A similar cruise will be held to Miami in January.

Left turns required

Violations of the traffic regulation against low flying are frequent among the offenses dealt with by the Aeronautics Branch, 44 having occurred during the second quarter of 1931. They were exceeded only by violations of the acrobatics provisions of which 65 were considered, almost 21 per cent of all the violations reported during the period.

A practice which is general among airports throughout the country, that of circling an airport to the left (counter-clockwise) when landing, will on Dec. 1 become one of the Air Traffic Rules of Air Commerce Regulations. In cases where wind or other local conditions require circles to the right, or right and left circles at different times, authorization must be obtained from the Department of Commerce and specified markings displayed to indicate the direction of turn by day and, in the case of airports lighted for night flying, by night as well.

Mexican regulations drawn

New regulations drafted by the Mexican Ministry of Communication and Public Works to be presented to the national legislature at an early date greatly strengthen and extend its control over civilian and commercial aviation. All aircraft with a capacity of more than ten passengers must hereafter carry a co-pilot. Civil aviation schools must be authorized by the Ministry and all instructors hold commercial pilots' licenses. Inspection and approval by the Ministry is also to be required of airports and of airlines, whose tariffs, itineraries, regulations and excursion rates must be submitted for approval at least fifteen days before the opening of service. The proposed regulations accord in general with those governing aviation in the United States, though more extensive in some respects due to the lesser degree of importance attached to states' rights in Mexico.

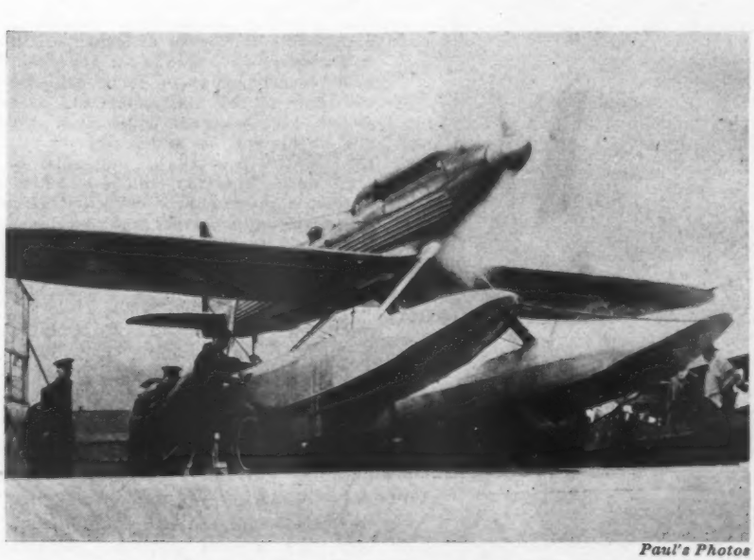
Four new planes have been ordered to further the work of the Airways Division. The Bellanca Aircraft Corporation was awarded the contract for two six-place high-wing cabin monoplanes, while the Curtiss-Wright Corporation, though underbid by the Stinson company, through closer adherence to the specifications received the order for two smaller planes of the same type, but with seats for only four persons.

The Akron flies

The U.S.S. Akron was flown successfully on its maiden flight Sept. 24 for three hours and 45 minutes over a course which included Cleveland and points in eastern Ohio. The ship carried 113 individuals, a recrod for an airship, about half of whom comprised the crew. Various accessories are being prepared for the ship. The Wellman Engineering Company of Cleveland, has received contract for a mooring mast, of the standard type which moves over railroad tracks, to be delivered to Lakehurst for tests, but destined eventually for the Akron's own base at Sunnyvale, Cal. It has also been urged by airship officers that an especially designed airship tender should be provided if the Navy is to derive the full value of operating the new 785-ft. airship directly with the fleet. The U.S.S. Patoka now serving in this capacity, has only one-third the speed of the other vessels and must be hustled off weeks in advance for any fleet rendezvous.

The problem of providing helium for the Akron is no small one, 6,000,000 cu.ft. of the gas having been shipped from the Bureau of Mines plant at Amarillo, Tex. In its two years of existence this government plant has produced in excess of 22,000,000 cu.ft. of helium at reported average cost of $11.47 per M cu.ft., and improvements in process and operation had reduced the cost, in June, 1931, to $5.95 for the same amount.

The program of the Graf Zeppelin for the past few weeks has been unusual even for that busy airship, including a tour around England as well as a round-



Paul's Photos

THE FASTEST AIRPLANE

One of the S.6B seaplanes developed for the 1931 Schneider Trophy Contest during which the world speed record was lifted to 385.1 m.p.h.

trip to South America, which is to be repeated shortly. After bringing 22 passengers from Germany to Hanworth Airport, near London, the Graf departed within an hour on a 24-hour tour of the British Isles with a new passenger list. Despite weather conditions impossible for airplanes, an interval of only seventeen minutes separated the landing of the tourists and the departure for Germany of still another group of 26 travelers. A short rest and an eight-hour trip over Switzerland were preparatory to its first non-stop trip to South America and eighth crossing of the Atlantic, on which 4,400 miles were covered in 72 hours, with thirteen passengers who had paid $1,000 each for the trip. Headwinds and cloudburst prolonged to 81 hours the return trip, on which the Zeppelin carried ten passengers and more than 200 lb. of mail. A repetition of the voyage was made Sept. 17.

To the stratosphere again?

Suggestions made by Prof. Auguste Piccard after his ascent into the stratosphere are beginning to materialize, the first evidence being a machine completed by the Farman company as part of a program for the development of high altitude flying sponsored by the French government. An air-tight cabin automatically supplied with oxygen, devices to feed fuel and prevent freezing, an adjustable four-blade propeller 17 ft. in diameter and a two-stage supercharger for the vee-shaped water-cooled Farman engine, equip this all-metal plane for altitudes above 30,000 ft. [See Engineering Section of AVIATION, April 20, and May 18, 1929.]

Several other interesting developments have come to light recently. The Standard Aero Starter Company of Pittsburgh has made the first application to aircraft engines of the explosive starter so frequently used on engines of stationary type. First tests of the new cartridge-type starter conducted on a Wasp engine by Air Corps engineers at Wright Field gave a satisfactory results. By the simple process of fastening a ¾-in. triangular strip of wood along the leading edge of the wing the Fairchild company has rendered a plane of difficult spinning characteristics sufficiently "spin-proof" to satisfy even Department of Commerce officials. The N.A.C.A. is now investigating the underlying theory Further reduction of flying hazards is promoted by two Frenchmen, Messrs. Ferrier and Bardel, who have developed a safer aviation fuel. Closely akin to the hydrogenation process fuels which have been the subject of experiment in the United States in recent years, it is similar in performance as well, since in cases where a crash occurs it will neither explode nor start a fire as will ordinary gasoline.

The long-rumored Russian transport plane is reported as having successfully passed tests conducted by the Central Aerohydrotechnical Institute. Five engines produce 2,400 hp. to carry 36 passengers and a crew of five.

Wide World

NEW YORK AT LAST

The Conqueror-powered Dornier Do.X passing the Battery at the end of its adventurous trail.

Bookkeepers report

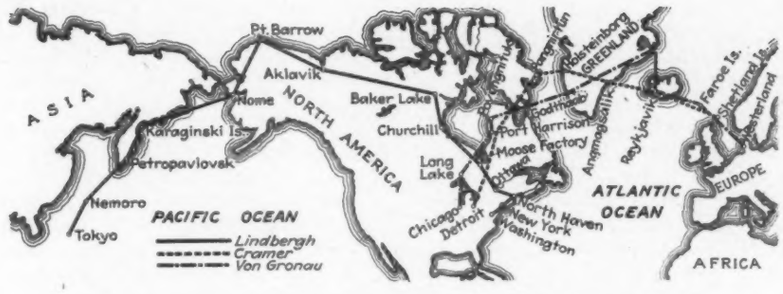
Reduced operations at the plants of the Pratt & Whitney Aircraft Company its hitherto most productive subsidiary, is responsible for the unusually small increase in the income of the United Aircraft & Transport Corporation for the second quarter of the year over that of the first three months. Net income amounted to $841,456 after depreciation, minority interests and federal taxes, only $34,808 or 4 per cent over the first quarter of this year, when earnings, after dividend requirements of the 6 per cent preferred stock, were 30 cents a share on 2,083,791 shares of common stock outstanding. During the second quarter of 1931, earnings were 31 cents on each share of common stock as compared with 51 cents for the same period of 1930.

The second quarterly report of the Curtiss Aeroplane & Motor Company shows a net profit after charges, of $80,060, as compared with net loss of $46,515 in the preceding quarter and of $138,061 in the second quarter of 1930. The first half of 1931 records a net profit of $33,545 against a net loss of $199,510 for the same period last year. The Curtiss-Wright Corporation as a whole continues to show a loss, the net figure after depreciation, interest and other charges being $375,030 for the second quarter of 1931, while the net loss for the three months ending March 31 was $1,088,124. The net loss for the first half of the current year was $1,463,154 as compared with $5,351,661 for the first six months of 1930.

Legal decisions

The material immediately following, together with references to legal and legislative matters elsewhere in the news pages, is based largely upon the Aviation Law Service prepared by the Commerce Clearing House, Inc. AVIATION is licensed to make use of this service, and is able to give its readers the benefits of the work of an organization specially trained and equipped to insure the complete collection of pertinent material on current legal developments.

Suits concerning the operation and reliability of flying services are appearing in law courts with greater frequency. The Transcontinental Air Transport, Inc., is being sued for $5,306 for damages to a single-engined plane of the U. S. Airways with which a T.A.T. tri-motor collided in taking off from Kansas City Airport. The complaint is that the T.A.T. pilot was not only taking off on the wrong runway, but also violated the regulations of both the airport and the Department of Commerce in starting to take off while another plane was landing. Roosevelt Field, Inc., which sued Alfred J. Richey of New York for $500



PENETRATING THE SUB-ARCTIC

Routes of three recent flights affecting future airways to Europe and Asia

in default of fare for transportation, is defendant in a countersuit for $900,000 loss because of the failure of the plane to transport him to Miami as promptly as stipulated in the passage agreement. Richey holds that an inexperienced pilot and and defective compass was the cause of his being landed in Jacksonville instead of Miami, while Roosevelt Field, Inc., blames the weather and "Acts of God which cannot be controlled."

Decision of the Oaklahoma Supreme Court and Attorney General sets a precedent in another case. The Court holds that an airport or flying field where planes are built or repaired or flying taught, is a "workshop," as the terms is used in the Workmen's Compensation Act, and therefore liable in the case of accidental personal injury sustained by persons employed as instructors or mechanics.

The states of New Jersey and Tennessee are now on the almost complete list (28 states) of those requiring licensing of all aircraft and pilots in accordance with the requirements of the Department of Commerce and the Air Commerce Act of 1926. The New Jersey State Aviation Commission specifies in addition that all air meets, races, exhibitions or acrobatic demonstrations be authorized by the State Department of Aviation. The legislature of Tennessee while authorizing the counties and municipalities to establish airports and providing for the acquisition of property for them, and further authorizes the acquisition of air rights for traffic and transportation over adjacent property thus meeting the problem of the ownership of air. Connecticut, on the other hand, authorizes the Commissioner of Aeronautics to close any airport judged by the superior court of the county in which it is located to be a menace to life or property.

New code for legislature

The Committee of Aeronautics of the American Bar Association has drafted a new uniform aeronautical code extensively revising the form drafted in 1922, to be submitted to all state legislatures for their approval. Whereas the original code recognized the ownership of air space by the owner of the surface beneath, in the revision flight of aircraft is judged a public right in all "navigable air space," defined as air space above minimum safe altitudes of flight prescribed by regulation. The principle of the absolute liability of the owner of aircraft for injuries caused by it, though incorporated in the British Air Navigation Act and in nearly all foreign statutes, as well as in the Code Internationale Navigation Aerienne of 1919, is considered erroneous in law and inequable, since it makes no discrimination between injuries due to unavoidable accident and those clearly due to negligence.

The proposed code, while it presumes the weight of evidence against the aviator, after the manner of French law holding him guilty unless he proves himself innocent, permits him to establish in his own defense such circumstances as contributory negligence on the part of the plaintiff, act of God, or lack of employment relationship between owner and operator. In regard to licensing the code proposes that the "single standard" of federal license for airmen and aircraft for all types of flying, already adopted by more than half the states, be made general, and brushes aside the argument that state constitutions prohibit any such direct delegation of power by legislation to the federal government. The power of municipalities to acquire, improve, operate and police airports (even outside their city limits), questioned by the courts in some states, is definitely authorized in the proposed air code.

Connecticut crash decision

Though investigation of the Army air crash at Newington, Conn., on July 20, in which two men were killed are being made from three different sources, it is upon the findings of one that the future of Commissioner of Aeronautics, Charles L. Morris and his deputy, Jack Lenox, depend. The Department of Commerce and the War Department has issued no statement of findings, but the Connecticut grand jury has declared Lenox guilty of flying too close to the other formation causing two of them to collide, and Morris lax in not conducting an investigation of the matter. The decision of Governor Cross, in regard to the prosecution of the Commissioner and his deputy, awaited with much interest in Hartford, is complicated by the statement of Lenox that he was no nearer the Army planes than two miles, and that of other army fliers that there had been another plane present, which had disappeared, as well as by the silence of the federal departments.

Airlines in busy season

Reports from a number of leading airlines indicate that passenger traffic volume continued high during July. United Air Lines carried 6,215 persons in that month as compared with 4,644 in June. Transcontinental & Western Air carried 867 more passengers in July than in June. American Airways established a new company record by transporting 5,915, an increase of 18 per cent over the total of 5,035 carried the previous month. This company accommodated 2,242 on its New York-Boston line alone. Up to Sept. 1, Century-Pacific Lines had averaged about 1,200 passengers each week since the start of operations in July; it is to increase schedules soon. Speculations continue regarding Century's plans for services through the Southwest, and in the New York and New England areas. W. F. Bliss, general manager, has been making surveys of a nature to prompt local interests to expect an early start of each one.

Newark Municipal Airport reached its traffic climax of the season during the four days of Labor Day week-end when a total of 2,980 were cleared in and out of the port on the transcontinental and short lines. Ludington Line operated six extra sections on Labor Day and American Airways turned down 200 applications for its Boston run.

The first serious accident to a plane of Boston-Maine Airways—the line sponsored jointly by the Boston & Maine and the Maine Central railroads, and operated by Pan American Airways—occurred Aug. 27 when a Sikorsky S-41 foundered in rough water during a forced landing in fog off Marblehead, Mass. The hull of the amphibion was broken open by the impact and an elderly man was drowned. The other nine passengers and crew of three were rescued after they had taken to a collapsible rubber raft. The company has added one flight each way daily over the Boston-Portland (Me.) section, making a total of four each way daily.

New York ferry line started

Curtiss-Wright Flying Service opened on Labor Day a ferry service linking Newark, Floyd Bennett Field and Glenn Curtiss Airport. A Ford is flown from Newark on the even hour, departing from Floyd Bennett at approximately

20 min. past the hour and from Glenn Curtiss for Newark at about 40 min. past the hour. Each leg is slightly more than 10 miles long; the fare is $5 for the round trip and $2 for any leg. The service was well patronized during the first weeks of operation, apparently as much by aerial sightseers as by those using it for convenience.

Robertson Airlines has introduced express service on its St. Louis-New Orleans route in cooperation with the Western Union. Passenger fares have been reduced, the through fare being $31.50 ($0.05 per mile) instead of $37.80 ($0.06 per mile).

Panagra wins Chile concession

Pan American-Grace has succeeded at last in obtaining permission from Chile to carry passengers as well as mail over its route into Santiago from Peru. Passengers may now fly all the way from Miami to Santiago by Pan American instead of changing to a Chilean National Airways plane at Arica.

Pan American has secured a substantial stock interest in Colombian Scadta lines, one of the most successful and one of the oldest (it was founded in 1922) airlines in the world. Passenger, mail and express services of the two lines will be closely coordinated. Scadta has 2,500 mile of airways, Pan American operates 19,000. There will be one P.A.A. representative on the Scadta board of directors.

Lines win hearings

American Airways and Century Airlines have been granted certificates of convenience and necessity for operating between Chicago and St. Louis. These petitions were granted by the Illinois Commerce Commission following hearings in May during which the Chicago & Alton Railroad objected strenously to a grant on the ground that airline service is dangerous and not dependable. The protest was later withdrawn.

New York & Western Airlines, operating between New York and Pittsburgh, has put on three additional Lockheed Vegas, and Transcontinental & Western Air has bought seven Northrop Alphas for extension of its Kansas City-Los Angeles night mail service east to New York City. Ludington has acquired two Lockheed Orions for a 68-min. non-stop passenger service between New York and Washington, supplementing its hourly service. Two trips daily in each direction will be flown.

Imperial Airways plans

Imperial Airways nas opened in the heart of London a new Airway Terminus Building which serves as executive headquarters of the company and as city passenger station. Buses run direct from there to the Croydon Airport. The company now hopes to open the Mwanza-Cape Town section of its African service in December, depending upon the delivery of the Handley Page 42 (Hannibal) type which will relieve De Havilland Hercules machines, now on the Cairo-Karachi section, for the new African section of 2,960 miles. A ten-year reciprocal agreement has been closed with Greece for the operation of Imperial Airways planes across Greek territory on both the African and Indian services, thus completing arrangements for operations in the Mediterranean zone. One of the new Hannibals was forced down in England early in August when a propeller broke, damaging a second engine. In the landing the tail was sheared off by wires but the machine was not otherwise seriously damaged and no one was injured.

The Argentine Air Transport company, one of the South American subsidiaries of Aeropostale, closed its third year with a loss of $907,601, an increase over a loss of $84,686 for the year before.

Air mail developments

The grumblings about the Post Office Department's methods and terms in granting air mail contracts has centered recently around criticisms advanced by Ludington Line, one of the strongest of the independent operators claiming they have been slighted. Ludington has announced it unsuccessfully offered to carry the mail between New York and Washington for $0.25 per mile as compared to the minimum of $0.40 received by Eastern Air Transport. Ludington's alleged interference with the operation of additional planes by Eastern (which uses Ludington's Central Airport in Philadelphia) has caused the Post Office Department to threaten to transfer mail activities now at Central to the Philadelphia Navy Yard field. Representative Clyde Kelly of Pennsylvania, member of the House Post Office Committee and sponsor of the original contract air mail bill, has declared he will instigate a Congressional investigation of the Post Office methods, if the inquiry already provided for in the House Appropriations committee does not satisfy him. Mamer Air Transport has joined the independents in their fight against present methods of awarding contracts.

New ship-to-shore mail record

Impressive demonstrations of ship-to-shore air mail deliveries were made in August by the Bremen's plane and in September by the Europa's machine. The Bremen plane left the ship when it was 700 miles from Boston on Aug. 18 and landed in Boston harbor at 6 that afternoon. Its mail was received in New York City the next morning, while the Bremen was not due until late the afternoon of Aug. 19.

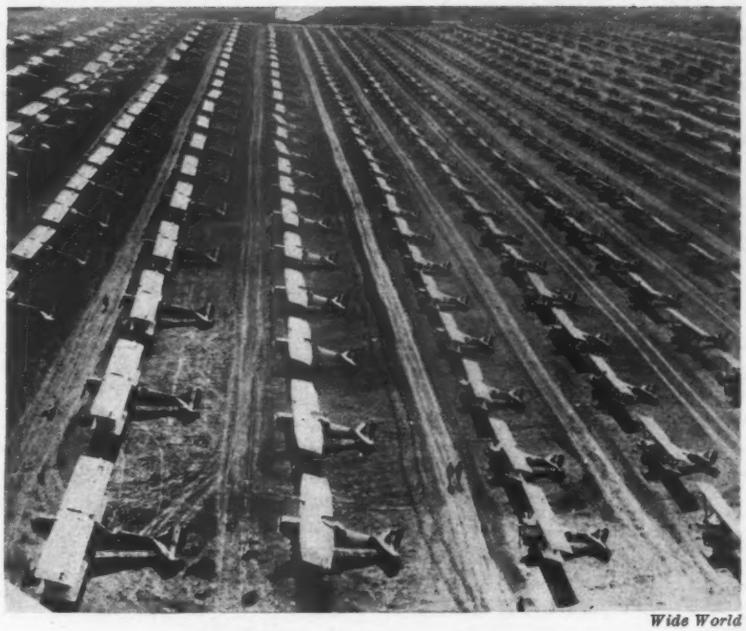
The Europa's machine surpassed this performance by leaving the ship on Sept. 8 while it was 600 miles from Sydney, Cape Breton Island. After landing at Sydney about 5 that afternoon the plane was refueled and flown to Bridgeport, Conn., where it was fueled again. It arrived off the pier in Brooklyn 22 hours after leaving the ship and about 28 hours before the steamer was due to dock.

Canada adjusts mail situation

The routes to be dropped from the Canadian air mail system have been selected and the reduction is not any-

FIRST IN CIRCUIT OF ITALY

Angrigui Colombo standing beside the Breda 33 which he flew to victory in the second annual light plane race around Italy.



Wide World

MORE MANEUVERS

About 800 planes of the Italian military air force parked during the recent annual exercises at Ferrara Airdrome in northern Italy.

where near as extreme as was expected when it first loomed late last spring. On Aug. 16—when new contracts superseded the temporary ones under which Canadian Airways, Ltd., had been operating since June—only two other services were dropped, making a total of five. The last two are the Montreal-Toronto service and the Medicine Hat-Saskatoon-North Battleford Loop of the prairie services. The three previous cancellations were the Montreal-Moncton-Saint John, N. B.; Montreal-Quebec and Toronto-Buffalo lines.

Those dropped have been the less heavily patronized lines, not considered part of the trunk system. Among those retained are the Montreal-Rimouski service which connects with trans-Atlantic steamers, and the international services into this country. Edmonton, about 300 miles north of the U. S. border in Alberta is reached now by way of Calgary only. The only pay change is reduction 90 to 75 cents per mile on the Toronto-Detroit service.

Canadian Airways officials are now inspecting the Avro 627 mail plane especially designed in England for Canadian operators. The machine looks much like a typical Douglas or Stearman mail biplane. It is fitted with an Armstrong Siddeley Jaguar Major engine of 525 hp., is equipped with a Townend ring, cruises at about 140 m.p.h., and, with a full load of 870 lb., has a range of 600 miles.

Move radio range beacons

Amplification of the federal airways system during the present fiscal year will include installation of 30 radio range beacons and completion of fifteen beacons now under construction. Fifty-one are in operation already. To the 48 radio communication stations now in operation there will be added eleven now under construction and ten others not yet started.

The new route of the New York-Washington airway has been selected and rotating beacons will be realigned soon. It follows much the same course as the old airway but has Newark as its northern terminal. Survey was to be started about Oct. 1 on the proposed lighted airway between Louisville and Dallas by way of Nashville, Memphis, Little Rock and Texarkana. It probably will be ready for night operation by early spring.

The third of a proposed series of 92 sectional maps, considered by the Department of Commerce an improvement on the contemporary strip map and likely to eventually supersede that type, has been published. Known as Upper K-17, it covers the Detroit-Toronto region between 2 deg. of latitude and 6 deg. of longitude, or a territory roughly 320 miles from east to west and 150 miles north to south. Previous section maps are centered about Chicago and Milwaukee.

Airport affairs

The Department of Commerce has issued a new bulletin, designated as Aeronautics Bulletin No. 2 on the subject of design and construction of airports. It is compendium of the Airport Section's data on trends in airport matters with a few prophecies thrown in. Emphasis is placed on the need for better coordination of airport construction plans with work of other branches of the industry in the future. Roof landing areas in congested districts are considered only a remote possibility.

The mild epidemic of airport fires last spring has been followed by a better record. August's most serious blaze occurred at Lunken Airport, Cincinnati, where eight complete Aeroncas and thirteen Aeronca fuselages were damaged to the extent of about $13,145. Defective wiring in the hangar was given as a probable cause.

The new building program at Selfridge Field, which will include four new hangars, an administration building, officers' and enlisted men's quarters, is well under way. National Air Transport's new $125,000 hangar and office building at Kansas City (Mo.) Municipal Airport has been completed. The $54,000 administration building at Oklahoma City Municipal Airport should be finished by early fall. Curtiss-Wright Flying Service closed its Mars Hill, Indianapolis, activities with the sale of its hangar, built at a cost of $129,000, to the Indiana National Guard Observation squadron for $35,000.

Personnel changes

Reed G. Landis, war ace and prominent in many phases of aeronautics, and Prof. Fred D. Fagg, Jr., of Northwestern University, who has done much work in the development of air law, are among those who have been appointed members of the Illinois State Aeronautics Commission.

C. L. Egtvedt, formerly chief engineer, has been named vice-president and general manager of the Boeing Airplane Company. G. W. Carr has been made plant manager.

C. E. Brink, formerly treasurer of the Boeing Airplane Company now is treasurer of United Air Lines, and H. E. Bowman is treasurer of Boeing.

Capt. Walter L. Avery, former manager of Curtiss-Wright Airport, Valley Stream, L. I., has been appointed operations manager at Roosevelt Field, succeeding Capt. Nelson Kelley, now at Floyd Bennett Field.

Amzi Barber has been appointed State Commissioner of Aviation in Alabama.

Roy E. Osborne has been appointed state inspector of airports in Kentucky.

Nathaniel E. Duffy, manager of the Buffalo Municipal Airport since its completion several years ago, has resigned.

Farr Nutter has resigned from the American Cirrus Engine Corporation.

J. A. Allard, for more than three years vice-president of the Curtiss-Wright Export Corporation, has been made president of the Curtiss-Wright Flying service as well, replacing Major Brainard, president of the flying service for about a year, who has resigned.

Statistics of the Month

Material supplementing the statistical issue, AVIATION, March, 1931, appears regularly each month. Page numbers in the statistical issue are given.

PRODUCTION AND LICENSING
(Page 136)

Aircraft Production from Jan. 1 to June 30, 1931

(Based on Department of Commerce Licenses, Identification marks issued for Unlicensed Aircraft, and Reports.)

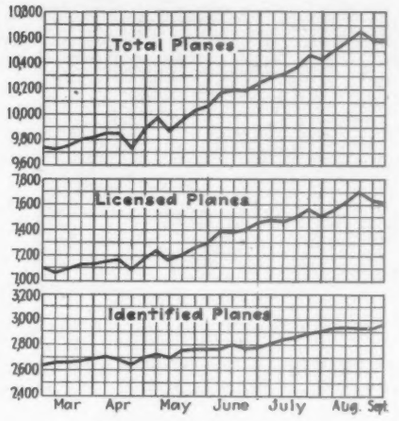
Monoplanes		750
Open cockpit landplanes		544
One place	176	
Two place	356	
Three place	10	
Four place	2	
Cabin landplanes		187
Under four place	32	
Four place	78	
Five and six place	11	
Seven to ten place	22	
Over ten place	44	
Convertibles, amphibions, seaplanes and unspecified		19
Biplanes		277
Open cockpit landplanes		255
One place	18	
Two place	97	
Three place	126	
Four and five place	14	
Cabin landplanes, four to seven place		15
Amphibions and seaplanes		7
Autogiros		40
Helicopters		2
Total commercial		1,069
Military airplane deliveries		480
Airplanes exported*		57
Grand total		1,606

*Does not include planes exported in 1931 which were manufactured prior to Jan. 1, 1931.

COMPARISON of airplane production figures for the first half of 1931 released recently by the Aeronautics Branch of the Department of Commerce with those for the same period last year show surprisingly little change. The current production totaled 1,606 planes, of which 1,069 were for civil use while in 1930 the figures were 1,684 and 1,177, from which the decreases have been 5 and 9 per cent. The Aeronautical Chamber of Commerce reported 1,453 planes, 982 for commercial use, produced in the first half of the current year, the discrepancy being due to planes made by individuals and for experimental purposes, which are reported only to the Department.

Of the 1,069 planes built for civil use in the first half year 750 were monoplanes, representing an increase of 33 per cent over last year, while production of biplanes dropped 54 per cent to 277.

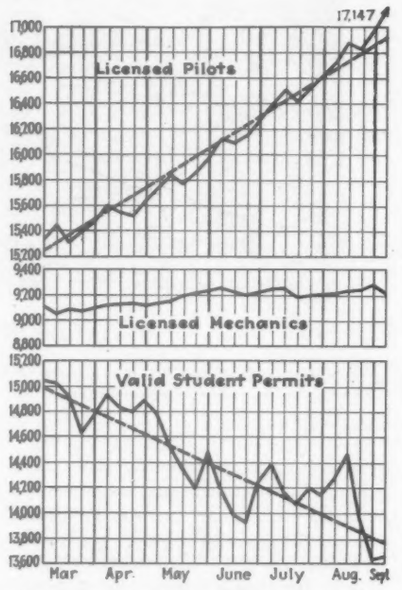
Now that the curve for total planes has overcome the jinx of the 10,000 mark a definite tendency toward stabilization is evident. Though a slight drop occurs at the end of both July and August, an average increase of about 35 planes each week is general. The increase



Valid airplane licenses and identifications

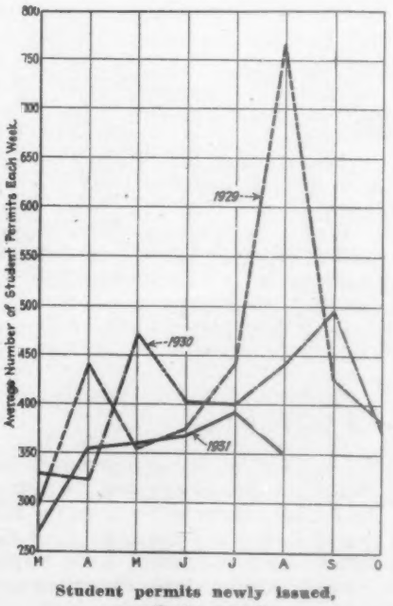
since early August is due entirely to licensed planes.

THE contrast between the tendencies of the curves for the two more important classes of flying personnel, licensed pilots and students, is emphasized by dotted straight lines showing average change. The total of licensed pilots, which last year at this time was hovering around 14,000 during the last week in August jumped to the unprecedented height of 17,147. Valid student permits dropped to a new low point for the year, 13,645.

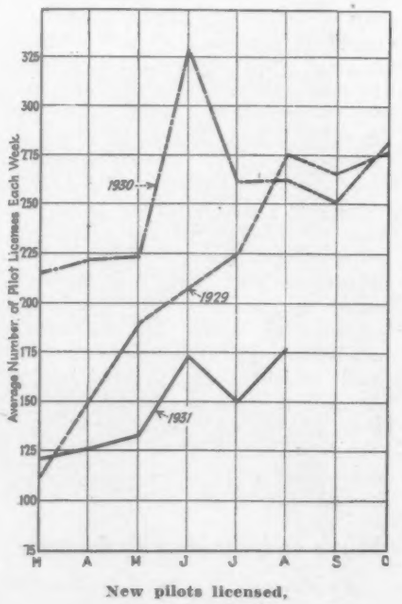


Valid pilot licenses, student permits in force and valid mechanics licenses

THE curve for average weekly issuance of student permits, after showing a



Student permits newly issued, month by month



New pilots licensed, month by month

tendency to follow the 1930 course, has again diverged to a point about 20 per cent below the previous year, while the current average of pilots licenses issued each week though still well below the 1929 and 1930, is on the upgrade.

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AIR MAIL AND TRANSPORT
(Page 153)

As of Sept. 1, 1931, just under 50 per cent of the total mileage flown daily under the American flag can be accounted for by the operations of three companies. The leading five companies in the aggregate did 63.3 per cent of the total amount of flying, while the leading ten covered 83.4 per cent. The figures for the ten leaders were:

	Mileage Schedule Daily	Per cent of Total
United Air Lines	28,224	18.6
American Airways	27,444	18.1
Transcontinental & Western Air*	18,922	12.4
Eastern Air Transport	11,020	7.3
Pan-American Airways	10,572	7.0
Century Air Lines	9,194	6.0
N. Y., P. & W. Airway (Ludington)	6,294	4.1
Trans-American Air Lines	5,659	4.1
Bowen Air Lines	4,648	3.1
Northwest Airways	4,315	2.8
Miscellaneous	25,419	16.5

Based on the individual route mileage figures of the Department of Commerce

* Including Western Air Express.

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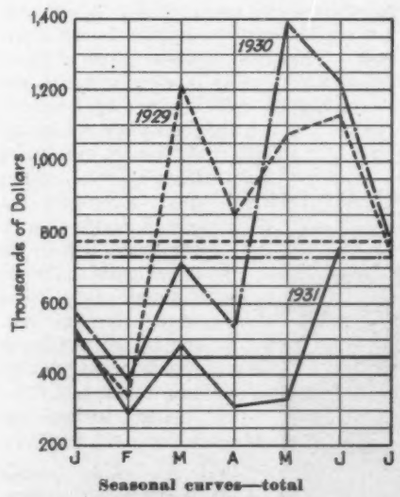
FOREIGN TRADE
(Page 168)

Aeronautical exports for the second quarter of the year, which in 1930 almost doubled the first quarter's figure, this year show an increase of little more than 7 per cent. The current depression is less responsible for the difference, however, than the abnormal situation last year when huge orders for planes to equip the new airlines of South America swelled the May and June totals to between two and three times the average for the earlier months of the year, and the quarter's total to $3,144,683, more than double the total for the second quarter this year. The effect of such orders on the curve of exports is evident in the accompanying graph, which also illustrates the position of current aeronautical exports relative to those of the two years immediately preceding. The horizontal lines give the average monthly value of exports of planes, engines and accessories for the years, with the exception of the solid line which is the monthly average for the first six months of 1931. The averages for 1929 and 1930 are similar, $778,000 and $730,000 respectively, while that for the current year is more than a third less.



Seasonal curves—total aeronautical exports

Aeronautical Exports for the Second Quarter of 1931

	Total Dollars	Airplanes No.	Airplanes Dollars	Engines No.	Engines Dollars	Parts and Accessories Dollars
Europe						
Azores and Madeira Islands	52	..	.....	..	.....	52
Belgium	6,517	..	.....	1	3,556	2,961
Czechoslovakia	11,000	1	11,000	..	.....	.....
Finland	25,278	..	.....	3	20,527	4,751
France	1,530	..	.....	..	.....	1,530
Germany	5,943	..	.....	2	950	4,993
Greece	1,500	1	1,500	..	.....	.....
Hungary	29	..	.....	..	.....	29
Italy	7,644	..	.....	1	5,193	2,451
Latvia	30	..	.....	..	.....	30
Netherlands	44,160	2	5,266	3	12,455	26,439
Norway	1,058	..	.....	1	959	99
Poland and Danzig	1,575	..	.....	..	.....	1,575
Rumania	1,835	1	1,835	..	.....	.....
Soviet Russia in Europe	189,975	..	.....	18	142,998	46,977
Spain	4,000	1	4,000	..	.....	.....
Sweden	549	..	.....	..	.....	549
Switzerland	621	..	.....	..	.....	621
Turkey in Europe	43	..	.....	..	.....	43
United Kingdom	110,344	2	76,348	2	11,611	22,385
Yugoslavia and Albania	37	..	.....	..	.....	37
North America						
Canada and Newfoundland	157,906	11	31,326	3	7,727	118,853
Central America						
Bermudas	98	..	.....	..	.....	98
Cuba	23,000	..	.....	3	10,050	12,950
Guatemala	4,556	1	2,400	1	1,200	956
Honduras	1,285	..	.....	1	1,107	178
Jamaica	73	..	.....	..	.....	73
Mexico	299,278	12	281,132	2	9,215	8,931
Other British West Indies	1,080	..	.....	..	.....	1,080
Panama	20,498	..	.....	3	14,170	6,328
Trinidad and Tobago	10,134	..	.....	2	9,094	1,040
South America						
Argentina	20,440	2	7,421	..	.....	13,019
Bolivia	32	..	.....	..	.....	32
Brazil	71,655	..	.....	5	17,338	54,317
Chile	79,634	1	58,602	1	2,500	18,532
Colombia	15,812	..	.....	3	14,805	1,007
Peru	18,790	..	.....	2	10,500	8,290
Asia						
British India	34	..	.....	..	.....	34
China	147,417	4	103,870	9	31,300	12,247
Hong Kong	37,800	..	.....	6	35,400	2,400
Japan	37,716	..	.....	6	25,315	12,401
Java and Madura	8,488	..	.....	..	.....	8,488
Other Dutch East Indies	385	..	.....	..	.....	385
Oceania						
Australia	4,104	..	.....	..	.....	4,104
New Zealand	566	..	.....	1	482	84
Philippine Islands	25,204	1	5,050	..	.....	20,154
Africa						
Union of South Africa	379	..	.....	..	.....	379
Total	1,400,084	40	589,750	79	388,452	421,882

The figure for exports of airplanes is the most important item in current accounts for the second quarter, since it shows an increase of almost 84 per cent over the first quarter, in the face of decreases of 8 and 25 per cent in the export of engines and accessories. Mexico is the largest purchaser, with shipments of planes to the value of $281,132 in three months. Soviet Russia, which was first on the list of buyers in the first quarter, bought no planes, but eighteen engines and $46,977 of accessories. The steadiest customers of American aeronautical manufacturers are Canada and the United Kingdom, which ranked third and fifth on the lists for the second quarter, and second and fourth for the first three months of the year, the total values of exports to both countries not varying more than 5 per cent in that time. Exports to Canada were mostly of parts and accessories for assembly in the Canadian plants of American firms.

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FOREIGN ACTIVITIES
(Page 173)

(Page 174) Annual Airplane Mileage in Air Transport, 1930

Belgium*	497,000
Dutch East Indies	471,000

(Page 175) Passenger Traffic in Passenger-Miles, 1930

Belgium*	1,058,000
Dutch East Indies	2,295,000

(Page 175) Express and Mail Traffic in Ton-Miles, 1930

Belgium*	56,650
Dutch East Indies	23,820

(Page 177) World Distribution of Airports, Airplanes, and Licensed Pilots

Chile

Aircraft registered	33
Population per plane	132,000
Civil pilots licensed	36

China

Airports	36
Auxiliary landing fields	71

*Does *not* include lines operating in the Belgian Congo

Design at the races

The contesting planes at Cleveland exhibited refinement in design rather than originality

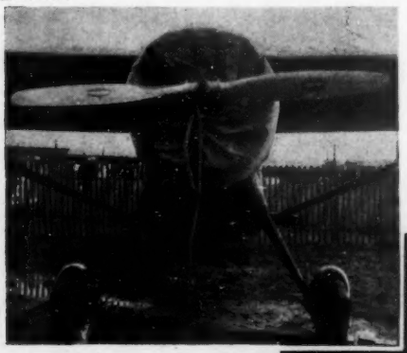
AS WE look back over the designs introduced in the last two years of national air racing, there is a definite decrease in originality, and engineers seem satisfied with existing types and contented to continue expending their efforts toward the refinement of present-day machines. Each year shows increases in the value of maximum speed, but much of the credit for this must be given to the engine designer. The most obvious method of increasing speed is to increase available power, and this is accomplished most efficiently through the use of supercharging. Thus each year race results reflect advances in this branch of engine development.

The airplane designer concerns himself with reducing wing area and with efforts to obtain a closer approach to the perfect streamline form for has machine. Most of the contesting machines of 1931 were refinements of last year's designs, and practically all were developed along conventional lines. The exceptions were the Gee Bee Supersporter and the machines equipped with retractable landing gears. In the Gee Bee design progress has been made in the solution of the problems inherent in airplanes embodying such close coupling of wings and tail surfaces on relatively short fuselages. The retractable landing gears on the Lockheed and San Franciscan planes and the development of the non-retracting variety were interesting.

In general arrangement the non retracting gears used in this year's planes showed a trend toward the type used on the Curtiss racer designed for Lieut. Arthur Page in the 1930 Thompson Race. These undercarriages are of the two-unit type and were used on the Gee Bee, Laird, Monocoupe and other planes. While there was some variation in the forms of shock absorber mechanism involved, they were all constructed with the object of avoiding the interference effects of a multiplicity of struts, and all were neatly housed and faired in highly streamlined coverings.

In fact, the improved landing gear constituted the major improvement over last year's version in the Laird Solution. The 1930 Solution had a faired cross-axle type of landing gear, as did a number of the other competing airplanes in the Chicago National Air Races. This type of landing gear was a revival of an earlier form employed before the development of the divided axle type, except for the fairing of the cross-axle which was intended to produce additional lifting surface, as

Aviation



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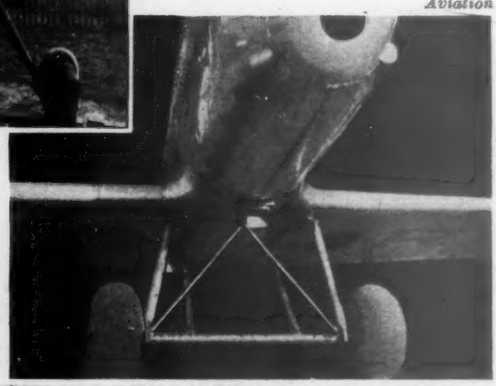
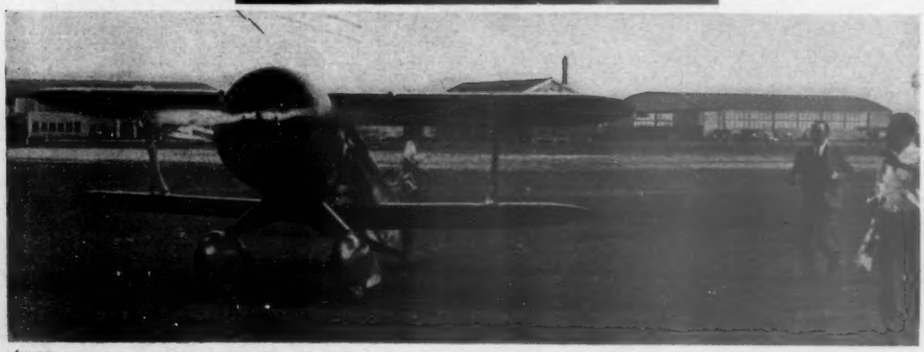
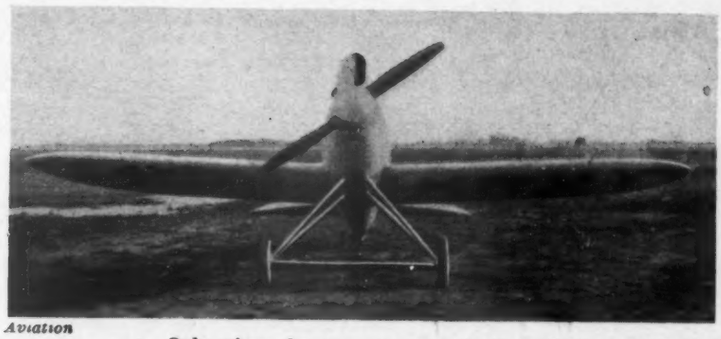


A study in landing gears. Above: The Livingston Monocoupe. Right: Retractable undercarriage of the Ryder San Franciscan.



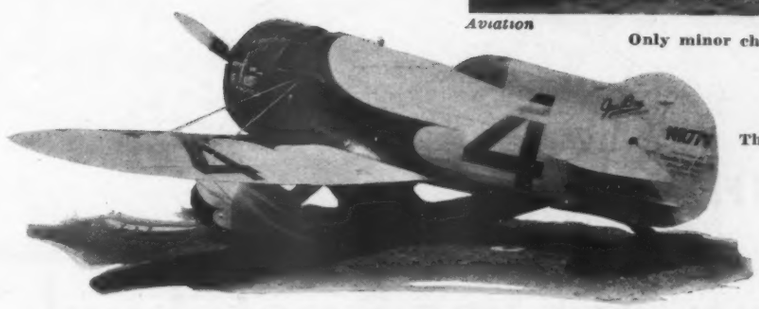
Acme

The new Laird Solution and its two-member landing gear.



Aviation

Only minor changes were made in the 1931 Howard Special.



The Wasp1powered Gee Bee Supersporster

well as to smooth the air flow around the axle. Such an undercarriage was retained in the 1931 version of the Howard special racer.

The retracting mechanism of the Lockheed machines is familiar, but that provided on the San Franciscan plane designed by Keith Ryder is somewhat new. The arrangement is simple, the angular travel of the wheels being in a fore and aft direction. In their extreme retracted position they are drawn only part way within the wing panels. An adjustable linkage is provided between the retracting mechanism and the horizontal stabilizer.

These machines constitute a redesign of the plane flown by Lieutenant Macready during last year's races, and two of them were rushed to completion for the races this year. As in last year's machine, the power plant was the Menasco inverted engine in its four and six-cylinder forms. Among the other improvements noted in these machines was the metal fuselage, resembling the Northrop structure in general form.

The use of cowling was universal on the racing machines, and its form was dictated largely by the type of plane to which it was applied. In the case of the in-line-engined planes the cowling problem was relatively simple. For the radials, however, several different types of cowling were in use ranging from the simple Townend ring to the complete cowling of the N.A.C.A. type.

Representing a compromise between the extreme N.A.C.A. and Townend ring cowlings, the arrangement used on Livingston's Monocoupe provided an excellent adaptation for similar types of cabin monoplanes.

Much attention was attracted by the very complete streamlining of the Gee Bee Supersportster, and several of the spectators referred to the machine as a "flying engine nacelle." From the N.A.C.A. cowling to the tail, nothing was permitted to interfere with the streamline form except the diminutive wings and tail surfaces and the cockpit enclosure which was built so far back that the head-rest could be faired into the vertical fin. The close coupling of wings and tail surfaces and the very small span necessary to provide the 70 sq.ft. of wing area are features which distinguish this machine from others of the general low-wing type. In speed trials over the one-mile course this plane averaged 269 m.p.h.

Aviation

The Compromise type of cowling on the Livingston Monocoupe

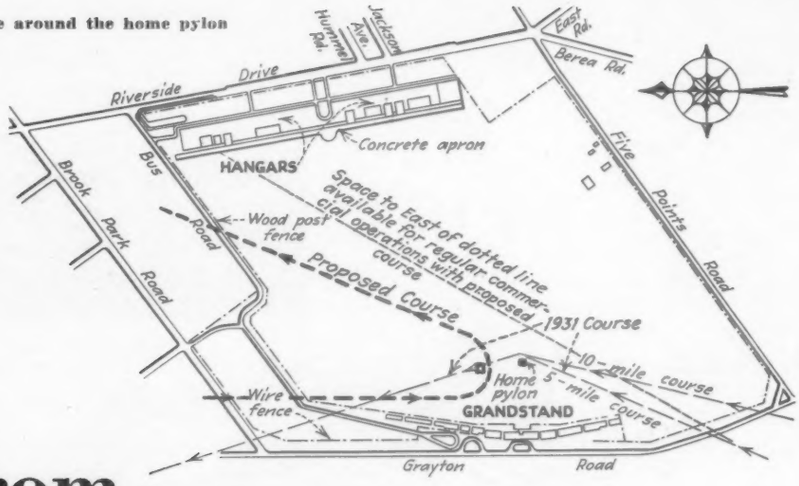
Cessna machines with Wright and Kinner engines and a Lambert Monocoupe were flown very creditably by Miss Florence Klingensmith, and various versions of the Gee Bee other than the Supersportster were prominent among the winning planes. The J-6 Waco flown by Miss Gladys O'Donnell was several times victorious. A new variety of Heath plane, powered with the Heath engine won the Men's 275-cu.in. Free-for-All.

The engine used in the Gee Bee Supersportster, winner of the Thompson Trophy Race, and in the Laird biplane, winner of the Bendix Trophy and the transcontinental record, were almost identical in design — Wasp Juniors with the gear ratio of the General Electric superchargers changed to 10:1 for supercharging, and operated at a 6:1 compression ratio. They developed approximately 540 hp. at 2,350 r.p.m. There were many other examples of the use of supercharging to increase engine output, and in a number of cases, supercharging alone was employed to increase the high-speed performance of airplanes that were in other respects stock models.

An excellent representation of vertical and inverted-in-line engines was to be found among the contestants, and it is difficult to overlook the aerodynamic benefits to be derived from the adaptability of these power plants to streamlining. While this is particularly true of the inverted engines, notably the Menasco and Ranger, a very high degree of refinement has been obtained in the machines typified by the Howard Special which was powered with a vertical engine, the Gypsy. Water-cooled engines were not used in any of the contesting planes.

Absence of originality was not confined to the racing machines but also was noted among the visiting planes, which were fewer in number than at the last two years' races. Of the several aircraft embodying aerodynamic or structural novelties displayed at the Chicago races last year, only the autogiro reappeared. It shows a continuous improvement in detailed design as well as in performance, and has been fully described in the July, 1931 issue of AVIATION. There were no machines to compare with the McDonnell Doodle Bug or the Waterman Variable-Wing Monoplane of the Chicago races. In fact, slots, flaps, and other variable-lift devices were not in evidence.

Proposed course around the home pylon



Pages from an air race notebook

By Edward P. Warner

THE management of the National Air Races are in the fortunate position of having a problem which changes but little from year to year. They have been gradually accumulating experience ever since 1920, and they can take several months to think over the successes and failures of each meet before the problems of the next are full upon them. That will be even more true in the future than in the past, for the races have now settled down at Cleveland for at least five years. This seems a particularly good time to sit down and study the record of the recent races, and to repeat such a critique as I have written on the national meets of two years past. [AVIATION, Sept. 28, 1929 and October, 1930.]

The affair at Cleveland was listed as a race meet, but it was true, as in previous years, that most of the crowd went home each day quite unconscious of having seen any races, or quite unaware of what the results may have been in such races as were held. The competition was incidental. It was the stunting show that made the turnstiles click, and as a stunting show the affair must first be judged. Al Williams, Dorothy Hester, Freddie Lund, the Army, Navy, and Marine Corps, and the foreign pilots assembled by Lieutenant Williams carried the burden of the week. Since the races as run at Cleveland would have been a popular failure without the stunting, the stunting deserves first consideration.

To criticise the flying would be profitless, and indeed impossible. The standard was as high as ever, which means that it approached uniform perfection. Though Lieutenant Atcherley's "crazy flying" was a little less impressive than at Chicago, since more of it was done with one wheel on the ground, it was still sensational, especially when introduced into his professorial vaudeville act of the closing days of the meet. Udet put on the same type of spectacular performance in defiance of all ordinary rules of discretion, and several of the other pilots entered Atcherley's chosen field to the extent of making it a regular practice to come in, wildly sideslipping and fish-tailing to preposterous angles, to a one-wheel landing.

Radio acrobatics

All stunting, even the crazy-flying type, looks very much alike and quickly grows stale. It is almost impossible to introduce real novelty, but the cooperation of aviation and radio succeeded in doing it in a couple of instances. Al Williams' *à la carte* acrobatics, operating to orders given over the radio, were undoubtedly high-water mark in that respect. For the first time in ten years of watching air races I was able to feel that stunting was definitely doing some good to aviation. There has never been a more impressive demonstration, for those who know nothing of air transport, of the perfection with which airplanes in flight can be kept under constant and instantaneous control by control from the ground.

An apparently incurable weakness which breaks out in these meets as soon as they become international is the total disregard of all precautionary rules. The American military and naval pilots were directly under the eyes of their commanding officers, and they were under orders to observe all the regulations. As a result, their displays seemed pallid by comparison with those of the foreigners, some of whom paid no attention whatever to any rules. It is easy to understand that pride in one's skill leads to the desire to make the most spectacular display of it possible when outside the borders of one's own country, but no skill is great enough to justify such risks. Our own Army and Navy authorities should make it a fundamental condition of their own participation in the future that reasonable safety rules should be imposed on all participants. All these things are said with the greater candor and emphasis because this year there finally occurred what has long been feared, and awaited with dread, a collision between two machines in formation. Fortunately Lieutenants Sanderson and Brice both emerged unhurt by the parachute route. Fortunately their position was such at the instant of collision, and their machines were so headed,

that they fell well away from the grandstand, but the accident was a new reminder that collision can happen between even the most skillful pilots, and a reminder also that when planes collide they do not immediately drop vertically beneath the point of impact. If they happen to be flying towards the grandstand at the time they can collide well out in the middle of the field and still fall in the crowd.

So much for the acrobatics. Now to the races, which furnished the nominal excuse for the whole fanfare.

Perfect timing organization

There was one feature of the race management that was so superlatively good that it should be mentioned at once. The timing organization was so far ahead of anything of the sort in any previous meet as to be quite beyond comparison with its predecessors. It is with some satisfaction that I look back to AVIATION of two years ago to find the observation in my own story that it ought to be possible for a group of competent timers and scorers "to get the time on every machine on every lap correct to within a fifth of a second and have a complete copy ready for the announcer and for distribution to the press within three minutes of the end of the race." Various people suggested at the time that the standard set was quite unattainable. This year it was not only attained but exceeded. With a group of fifteen men, each of whom had a definite job and did the same thing every day, the organization ran so smoothly that the time and the average speed of each machine on each lap was in the hands of the announcers within 45 seconds after the plane had passed the pylon and mimeographed copies of the full results of the race, with the time and speed of every machine, were being handed out to the press within two and a half minutes after the last plane crossed the line. First credit for the performance of course goes to Carl F. Schory, chief timer. Very special mention is due to A. J. Underwood, of the S.A.E., Mr. Schory's principal assistant, to W. L. Enyart of the N.A.A., and to the Marchant calculator operators who kept three machines whirling figuring the average speeds.

From the point of view of the spectator who wants some news of what is going on in a race, in order to get the maximum of thrill out of it, the timing is of secondary importance. The important thing is to get the information out. Radio announcing continues a major problem of air races and exhibitions. This year's announcing represented an improvement of approximately a thousand per cent over that of 1930. Most of the announcers were free from humorist complexes, and the broadcasting of personal appeals was reduced to a minimum. However, there still remains much to be done. The introduction of celebrities, recognized or self-elected, still consumes far too much time. From the perfunctory applause with which the crowd greeted each introduction except a very few there was no sign of any real interest in the supposedly famous men.

Racing and the loudspeaker

The general announcing was a good all-around performance. Its most conspicuous strength was in the handling of the exhibitions, when various experts took over the work. Lieutenant Chourré of the Navy, who apparently has a life job before the microphone, particularly distinguished himself by his calmness at the time of the Marines' collision. The most conspicious weakness was, as in past years, in covering the races. Whatever inherent possibilities of drama the competitive events possessed were smothered, and they were made as romantic as the multiplication table, by dreary recitations from the official entry list of the name of each pilot and the type of machine and engine that he was using, followed by interminable tabulations of average speeds given to six significant figures.

It is being said again after the Cleveland races, as it has been for several years past, that air racing is a failure as a public attraction; that its only effect on the audience is to put them to sleep. As for several years past, the present writer rises up to insist that it has never had a fair trial. The racing rules have never been properly devised to make the races interesting to the crowd, and the crowd has never really known what was going on. The long-continued chant of: "John Livingston's speed for three laps was 139.235 miles per hour; Vernon Roberts' speed for two laps was 124.256 miles an hour," and so on, does not come under the head of giving useful information. It is far more interesting to the crowd to know that: "Garrison was six seconds ahead of Robinson on that lap, and only four seconds the time before; he picked up another two seconds on that time around, but it looked as though Robinson gained a little bit on him on the turn," and the like. This

Aviation

Aviation

Above: Home pylon, scoreboard and finish line. Spot landings were made to the center of the circle.

Left: Timers and calculators, above, and judges, below, ready for work

matter of race announcing is one of the two outstanding problems for next year's organization. It should receive serious consideration long before the meet.

Score-cards at last!

In one respect the announcer's problem was simplified because, wonder of wonders, for the first time in nine years score cards were on hand for the spectators. For anyone who wanted them official programs were available, with complete lists of entries in the day's races and of their planes and power plants. That alone would suffice to establish the Cleveland meet's place in history.

For the first time since the Earliest Bird first flew, the spectators were seated in the middle of the race course and most of the race took place behind their backs. The experiment was tried to avoid conflict with commercial air traffic, leaving half the airport completely clear of interference by the races, and in the supposed interest of safety for the racing pilots and spectators. The latter consideration seems wholly fallacious. Admittedly there is great danger where, as at Chicago, the pilot who continues his course past the home pylon without making the turn will go straight into the grandstands, but in Cleveland no such condition existed. If anything there is more danger in turning towards the crowd, as at Cleveland, than in making a turn away from it, while the latter type is far more exciting to watch than the former. The avoidance of interference with commercial traffic is a delicate problem, but fortunately the prevailing wind at Cleveland is such that take-offs are practically always made across the field from left to right as seen from the grandstand. It would then be possible to leave the necessary part of the field clear for commercial traffic by setting the home pylon well to the left and making a very sharp turn (about 150 deg.) at that point. The course would be far more interesting to the crowd in that way, and there should be no increase in danger for the pilots. A suggested layout is shown in the sketch on page 576.

The standing start, with all the machines going together at the dropping of the same flag, again fully justified itself. One unfortunate feature of the standing start, however, was that all times were taken from the starter's flag and with the calculated speed based on the nominal distance around the course for a specified number of laps, making no allowance for the time lost in the standing start or for the distance of about two miles to the scattering pylon and back. In what was advertised as a 30-mile race the pilots actually had to fly 32 miles plus a standing start, and the speeds announced for such a race were in all cases about 8 to 10 m.p.h. below the true speed of the competing machine around a closed circuit. Last year the course was arbitrarily shortened to allow for the effect of the turns. This year it was arbitrarily lengthened to allow for the scattering pylon, with results almost equally unfortunate. The time of a race starting from a stand should in all cases be taken when the first machine crosses the starting line for the beginning of the first lap in full flight. The speeds announced will then have some definite significance in terms of the performance of the airplane. For example, the average speed announced for Bayles in winning the Thompson Trophy was 236.239 m.p.h., yet he actually flew five of the ten laps at over 240 m.p.h., and his average for the last nine laps, all those not directly affected by the standing start, was over 239.

Straight-away speed trials

In the endeavor to arouse interest in the racing a great number of "straight-away speed dashes" over a one-mile course had been planned for this year. When the machines contesting were relatively slow the straight-aways proved to be a total failure. They were much more interesting with planes as fast as Bayles' or Doolittle's.

The courses flown were shorter than in past years, and in that respect were an improvement, but they are still too long. As a general rule a race is decided in the first couple of laps. It would be more interesting to run a greater number of heats over distances of two or three laps. Fifteen miles, permitting the whole race to be finished in about seven or eight minutes, is the ideal length for all events except those for the very fastest machines.

The handling of the field end of the contests was, as usual, under the direction of "Pop" Cleveland. This section functioned with its usual smoothness.

Handicap races and amateur pilots

The announcing of the races has been mentioned as one of the two most serious weaknesses at Cleveland. The other was the continued failure to provide for handicap events. Nothing else replaces them in potential interest to the crowd, and even to the competitors. They have been neglected too long. There can be no possible excuse for failing to put them on the program next year. There is no space here to discuss in full detail the way in which they ought to be organized and the handicaps assigned, but that, and other matters pertaining to the detail of racing rules, will be covered in another article in an early issue of AVIATION.

Another good bet, strangely overlooked, was one-design racing. It would be well worth while to acquire at the expense of the Air Race management half a dozen identical machines of some medium-powered sport or training type and use them in a series of invitation races for well-known pilots, with the machines being assigned by lot in each heat. Although it may be that some of the pilots would have been unwilling to participate, there would have been particular possibilities as a popular attraction in a series of such races among the foreign pilots at the meet and some chosen American representatives.

At Chicago in 1930 the sportsman pilot races, first seriously tried there, proved a dismal disappointment. At Cleveland elaborate preparations were made for a group of amateur pilot events, but they ultimately disappeared from the program entirely, except for a single rather unsatisfactory race on the last day. Sporting competition in the air seems to be in a sad way. There are several reasons, but one of the most important was suggested in the reception given the sportsmen pilot's "Derby" that came into Cleveland during one afternoon's racing. It received only the most casual attention from the announcer and the management when it arrived, but the way had been nicely prepared for it by the local newspapers, which had habitually referred to it, presumably not without inspiration from someone engaged in aviation, by such endearing phrases as "Society Derby," "Blue-Blood Derby," and "High-Hat Derby." So long as the sportsman pilot, whether or not he is engaged in competition, continues to be an object of sneers, at least so long will the aircraft industry continue to wonder what is wrong with the private plane market.

In one detail of general organization the Cleveland meet was distinctly inferior to that at Chicago. There was not enough centralization of field control. Every such event should have a generalissimo placed where he can overlook everything, and equipped with a half a dozen telephones and microphones and a complete master control enabling him to cut in anywhere on anybody. His is the function of general supervision and of instant action in emergency. At Chicago Major Schroeder occupied such a post. At Cleveland there was no one, and no provision for him. Next year the uppermost level of the grandstand structure should unfailingly be set aside for that purpose.

It has become almost monotonous, in speaking of events managed by Cliff Henderson, to say that the general arrangements were close to perfection. The usual remarkable feats of collecting and training personnel were accomplished. Gatemen and ushers were, as usual, well informed, firm when firmness was necessary, and uniformly courteous. The provision for the press was excellent, and for that special appreciation is due to James H. Lanyon, Munson T. Adams, and John T. Nevill.

A duty and an opportunity that seems to have been overlooked by the several states of this country. It is to contribute to the development of intrastate private and transport operation of aircraft in anticipation of the future tax revenue to be derived from these sources. The federal government has done its share but there are legal limitations beyond which it cannot proceed. Some states have carried on from these limits. It is time that the others gave some consideration to the problem.

The opportunity of the states

By Charles L. Lawrance

President, Aeronautical Chamber of Commerce of America, Inc.

WHEN all business was on the boom in 1929, and aviation was carried with it, numerous airplane factories were built and thousands of planes produced in the belief that aviation was simply a new form of motoring lifted into the air.

When the general business boom subsided, and aviation diminished with it, there was a tendency to go to the other extreme and regard flying only as long distance transport analogous to the railroad train or steamship rather than the automobile.

Neither view was correct, and I feel warranted in now declaring, even when pessimism is popular, that aviation is rapidly approaching the time when the airplane will not only serve as a basic common carrier for the public but also as personal transportation for thousands of people who demand speed and are willing to pay for it.

The air mail and transport system, which today forms the backbone of commercial aviation, while of course performing a valued service between cities within the same state that are a considerable distance apart is essentially an *interstate* operation. The quantity aircraft production of the future will come as a result of the development of flying primarily *local* or *intrastate* in character.

It is a fact that our air transport system, which each 24 hours piles up 150,000 miles of flying, was created by and is dependent upon the policy of federal regulation and aids to air navigation, as established by the Air Commerce Act of 1926.

It is likewise true that private or intrastate flying will appear as a major factor in social and business life when —and only when—the several states recognize their opportunities and responsibilities. When extensive private flying will mean to the aircraft industry as a market and to the interstate air mail and transport system as a feeder, is indicated by the fact that in 1930—a stagnant year—9,500 airplanes in private or charter service, mostly within state boundaries, flew, it is estimated, approximately 136,000,000 miles and conveyed 3,000,000 persons. The opportunity of the states, is deliberately to encourage this phase of aeronautics. Their responsibility to do so rests in public obligation. The desired end, I believe, can best be achieved through the application of uniform rules and regulations in harmony with those promulgated by the federal government, and in the construction and maintenance of airports and aids to air navigation within state borders.

Little has been done thus far by the states as a group to encourage the development of aviation, even for their own advantage. Legislation governing the operation of aircraft within their borders was enacted by a number of states long before the Air Commerce Act of 1926 went into effect. Today, there is not a state in the Union that does not attempt to regulate or tax aeronautic activity in one way or another. Many have passed enabling acts, making it possible for counties and cities to acquire property and operate airports, but aside from the authorization of such agencies to spend money, the support accorded to aviation by the states has been largely passive. For the most part, they have been content to sit by, watching the federal government carry out its development program. Because of this, aviation has suffered and the states have deprived themselves of a constructive factor in their growth.

Before I treat in detail the situation, let me quote from the statement of policy which it was my privilege, as

president of the Aeronautical Chamber of Commerce, to present to President Hoover on March 5 last:

"We respectfully express the hope that nothing will interfere with the scheduled development of the system of federal airways by the Department of Commerce. We urge that this system be extended to the approximately 25,000 miles contemplated and that maintenance thereafter be provided for."

Whatever may be done by the states, therefore, must, in my opinion, be done only in such a way as to supplement the federal program. State aids cannot be substituted for federal. Any lapse in the orderly development and maintenance of the federal airways program will be disastrous to the air mail and transport system and consequently to the industry.

The purpose of the Air Commerce Act of 1926 was to encourage and regulate the use of aircraft. The manifest intent of the Department of Commerce, in the beginning under Hon. William P. MacCracken, Jr., as the first Assistant Secretary for Aeronautics, and for the last two years under Col. Clarence M. Young, has been to give the industry a maximum of encouragement and a minimum of regulation. Its restrictive and controlling rules, in the main, have been worked out with the cooperation of the industry through the Aeronautical Chamber of Commerce and consequently the industry to a large degree has had the privilege of self-regulation. This, of course, we confidently expect will continue.

When the Aeronautics Branch of the Department of Commerce was created, there was but one real airway in the United States. This was the New York-San Francisco transcontinental route operated by the Post Office Department. It had been lighted between Chicago and Salt Lake City to make possible the inauguration of a through day-and-night coast-to-coast service, and from Chicago to New York to meet the demand for an overnight service between those cities, a total distance of 2,042 miles. There were eighteen fully equipped landing fields along the lighted portion of the airway, and 89 intermediate fields. Electric beacons had been installed 25 miles apart and gas lights at three-mile intervals.

It was not until several months after the approval of the Air Commerce Act on May 20, 1926, that the Aeronautics Branch became a factor in American aviation. It naturally required some time to organize the new Commerce Department unit, even though the work was expedited by the decision to attach three of its five main sections to established bureaus. The Aeronautics Research Division, for example, was set up as a part of the Bureau of Standards, the Airways Maping Division as a part of the Coast and Geodetic Survey, and the Airways Division, which has charge of all matters pertaining to the establishment of aids to air navigation, as a section of the Bureau of Lighthouses. The latter division was the first to go into action, the first beacon installed by the Airways Division being placed in operation on the Chicago-Dallas route Dec. 7, 1926.

The appropriation for air navigation facilities, a portion of which is used annually to conduct research with a view to improving air navigation equipment, the first year was $300,000, but this sum was not sufficient to defray the cost of the work undertaken. As a consequence, Congress made $450,000 of the $3,091,500 appropriated for the next fiscal year available during 1927. The result was that 1,386 miles of airways had been lighted by the Aeronautics Branch at the close of the first year of its existence.

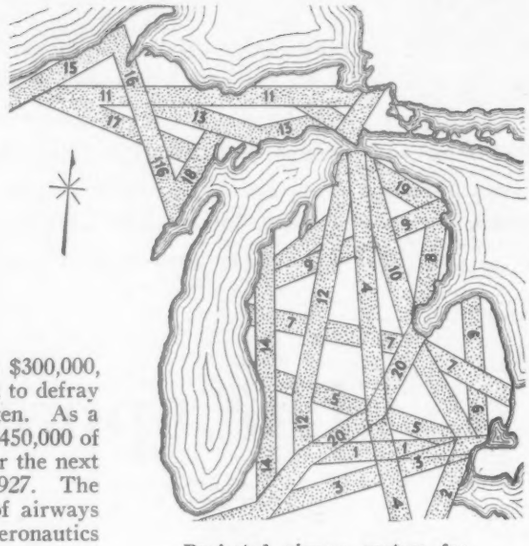
It will be remembered that service on the earliest of the privately operated domestic air mail routes was started Feb. 15, 1926. At the close of the calendar year, there were nineteen American air transport companies operating planes on regular schedules. All but one of these held mail contracts. The schedules of some of the lines necessitated flying in total darkness at the extremities of their routes, and it was to aid these operators that the efforts of the Aeronautics Branch were first directed. In all, 32 intermediate fields were constructed and 107 beacons installed.

Lighting the airways

Operation and maintenance of the transcontinental route was turned over to the Aeronautics Branch July 1, 1927, in accordance with the provisions of the Air Commerce Act, increasing the number of miles of lighted airways under the jurisdiction of the Department of Commerce to 3,448. Seventeen radio stations had been established by the Post Office Department for the dissemination of weather information, and these stations were transferred to the new aeronautics body also.

Including the transcontinental route, 5,880 miles of airways had been lighted at the close of the fiscal year 1928. The work accomplished during the twelve-month period consisted of the establishment of 74 additional intermediate fields and the installation of 407 beacons on fourteen different routes, besides improving equipment on the lighted portion of the New York-San Francisco airway. The following year, the mileage lighted for night operations reached 10,183.

The fiscal years 1930 and 1931 saw a continuation of the work of lighting the major air routes. Out of the 25,000 miles of airways which the Department of Commerce plans to equip for night flying, there are now 17,500 miles of airways lighted and under construction,



Projected airway system for the state of Michigan

which are, or will be, equipped with radio direction and communication facilities and weather reporting services. Including 2,000 miles of lighted airways authorized for the ensuing year, the airway program now embraces 19,500 miles. In addition to the foregoing, there are now 1,123 miles of airways which have been or are being provided with air navigation facilities for day operations.

I have said that the Post Office established seventeen point-to-point radio stations along the transcontinental route. There are now 52 broadcast stations, which broadcast reports on plane movements as well as weather information. There are also 51 radio range beacons of the aural type, placed at strategic positions along the nation's airways. Installation of visual radio beacons and marker beacons has been commenced too. The latter are used to indicate the intersections of radio range courses and in some instances the location of landing fields. These radio aids to air navigation are most important. Without them, blind flying wou'd be out of the question. As it is now, a competent pilot, skilled in the use of his instruments, can fly blind indefinitely so long as he follows a radio beam. The only thing that he cannot do as yet is to land when the ground is obscured.

An extensive airways weather reporting system has been created also. This has been developed through the combined efforts of the U. S. Weather Bureau and the Aeronautics Branch. The Weather Bureau now has a total of 53 completely equipped upper air meteorological stations, most of them located at airports throughout the country. These offices furnish weather information at frequent intervals both day and night to four principal collecting centers. In addition, reports are made twice daily by more than 200 regular weather bureau stations. This

information is further supplemented by reports transmitted by the "airways keepers," full-time employees of the Department of Commerce whose job is to care for the fields at their stations and handle messages coming in over the 13,000-mile automatic telegraph-typewriter circuit which connects the principal fields and the Weather Bureau offices.

It may appear to some that the Aeronautics Branch of the Department of Commerce has been and is doing all that is necessary to foster the growth of aviation. That is an erroneous impression. The Aeronautics Branch has done an exceptionally good job thus far, but its activities are definitely limited. It cannot, for example, aid in the construction of terminal landing facilities. It is prohibited by law from doing this. Neither can it be expected to engage in the construction of purely intrastate airways.

The illustration on page 582 shows the airways in existence Aug. 1, 1931. The black lines indicate routes that have been lighted; the shaded portions, day routes in operation; the broken black lines, night routes, and the broken shaded lines day routes that are under construction. The remaining mileage of the system is listed in the legend as "other routes." These 10,000 miles are other routes simply because some air transport company is flying planes over them. There are no landing facilities, other than municipal or commercial fields. There is no lighting equipment. There are no markers in the majority of cases, save for those erected by towns and cities and perhaps through private initiative.

These routes probably will be lighted eventually. But even bringing the lighted milage up to a total of 30,000 will not mean that we will have a truly national airway network. I can think of a dozen smaller cities off hand—cities that are not, but should be, receiving the benefits of air transportation. A study of a map of the United States would reveal hundreds of others in the same predicament. They are live communities, but simply are not large enough to receive recognition from the federal government in the form of airways.

Idaho sets example

The establishment of intrastate air routes that will join and supplement the federal system is a job for the individual states, one that should be started immediately. Some of the state governments have already commenced the work, though this condition is by no means general. Outstanding among this group are Idaho, Pennsylvania, Florida, and Michigan. Since Idaho, perhaps, has carried its work the farthest, I shall cite its development program as an example of what can be and should be done by the state government.

The Idaho Air Commerce Act became effective March 7, 1929. It provided not only for the licensing and regulation of aircraft and airmen, but set forth a policy of constructive cooperation in aviation development which included the making of a survey of existing conditions, designating air routes, establishing aids to air navigation and a uniform system of airway and airport markings, negotiating with other states with regard to the construction of interstate airways, creating a state aeronautics fund and the issuance of bulletins and maps concerning aviation.

An Aeronautics Division in the Public Works Department was created and a State Airways Engineer appointed. Mr. A. C. Blomgren holds that position, and has given an excellent account of himself. In this connection I should like to say that a director of aeronautics or an aero commission should be appointed in every state—some one person or group that is responsible for the development of aviation. Too often, if left to existing bodies, the fostering of this new form of transportation within the state becomes more or less a side issue.

That, however, has not been the case in Idaho. When the Aeronautics Division was created, and incidentally, its organization was effected with the aid of the Department of Commerce, there were only six landing fields in existence within the state. Today there are 47. Two of the orginal six were condemned as inadequate, so that in the last eighteen months 43 new ones have been constructed.

Of the total, twelve fields have been established by the federal government, four by the U. S. Forest Service, five by private interests, and six by the state. The remaining twenty are commercial and municipal airports. Twenty-five, including one of the Department of Commerce intermediate fields, have been built through the use of funds received from private individuals, airports levies for cities, county levies for airport purposes, and donations from the state.

The service rendered by the Idaho State Department of Public Works has been as broad as required in each case. It has ranged from the selection of the best available sites and the general planning of facilities to the actual testing of materials, the detailed designing of airport buildings, making estimate of costs and the preparation of stage construction programs. All this has been in addition to the material aid that has been rendered by the state in the construction and maintenance of various fields.

While it was thought best to develop individual fields to meet immediate needs, rather than to complete any one airway, the ultimate use of these fields as a part of the state airway system was kept in mind.

The Idaho airway development program includes the establishment of fields along the three federal airways that cross the state; the building of state airways between Boise and Pocatello, Boise and West Yellowstone, and Idaho Falls and West Yellowstone; the construction of interstate airways between Stanley Basin and Wells, Nev., Boise and Butte, Mont., Pocatello and Granger, Wyo., Boise and Burns, Ore., or Winnemucca, Nev., and the establishment of a Boise-North Idaho and a Pocatello - Salmon route which will feed into the federal airway system.

The state network totalling approximately 1,800 miles in length will supplement the federal system to a great extent. Before the work is completed sixteen more municipal airports and seventeen state fields will be established, including one forest emergency landing field at Lowman. Many of the ports that are planned will be a short distance off the airways. All of them, however,

The present state of airport and airway development within the state of Idaho.

will be near cities and towns, which is of tremendous importance. There is one thing that aviation needs badly and that is the development of landing facilities at the smaller communities. The Idaho program provides this very thing, and it is a plan that should be adopted by every state in the Union.

So far there has been no indication by state officials that the Idaho airways will be lighted. That is something which should be done at the first opportunity. In addition, the state should assume the responsibility of establishing a local weather reporting system, placing observers at strategic points throughout the state and linking the various fields with automatic telegraph-typewriter circuits. Radio aids to air navigation should be installed likewise. In this work, of course, the Aeronautics Branch of the Department of Commerce should be consulted, since uniformity is essential.

The motor vehicle analogy

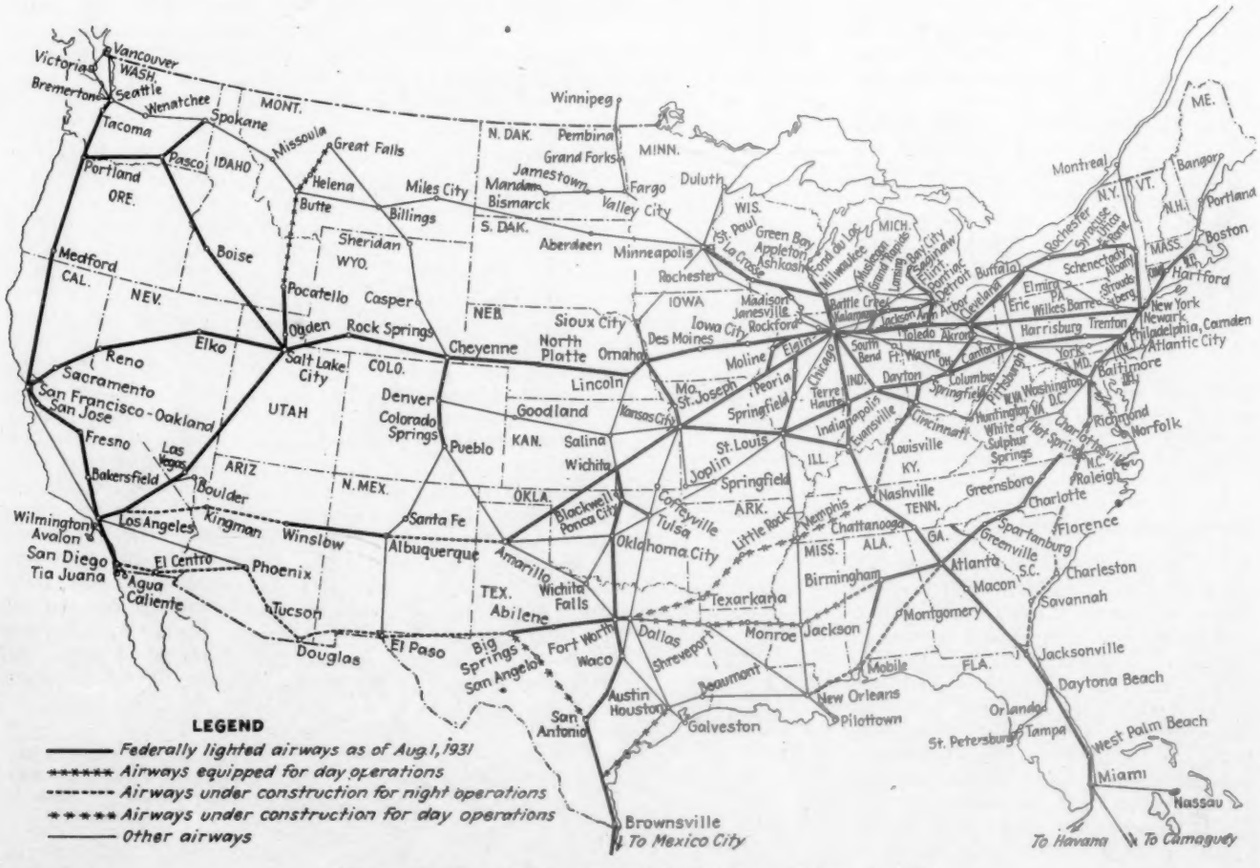
The revenue obtained from motor vehicle and gasoline taxes now pays approximately 41 per cent of the annual bill for the construction and maintenance of rural roads. Appropriations made for the purpose and funds obtained from general property tax account for 37 per cent, while the financial assistance extended to the states by the federal government in building interstate roads comprising the Federal Aid System accounts for about 5 per cent of the total. The remainder of highway construction funds is obtained from the sale of bonds.

Long before gasoline and motor taxes amounted to anything, however, the states were appropriating large sums for the development of hard roads. In 1926, the year that the Aeronautics Branch of the Department of Commerce was established, $621,744,210 was expended by the states of highways, exclusive of the amount contributed by county and local governments; in 1927, $648,483,055; in 1928, $764,648,134; and in 1929, $799,876,344. Last year, as a result of efforts made to aid the unemployed, state governments spent $887,535,011 on road construction. It would seem that they should be willing to do something for aviation. Expenditures made in the interest of aeronautics should not be limited to taxes taken from the aviation industry. The states should appropriate funds from the general revenues, liberally and consistently, with the thought that future return will be far greater than present cost. In addition, the states should do everything possible to encourage the construction of airports by municipalities, no matter how small the communities may be.

Private flying is dependent upon the development of intrastate airways and the creation of landing facilities in small communities. Lack of these things is one great reason why there are not more privately owned airplanes in this country today. The private owner wants to use his airplane as he would use his automobile. He cannot do it unless the states accept the opportunity and the responsibility for the development of aids to air navigation within their boundaries. The speed of the airplane means nothing if a man finds that he cannot land at his destination because there are no fields. It means nothing if he has to waste a part of his business day because there are no facilities for night flying. It means nothing if the route he wants to take is not clearly marked. Development of these facilities will aid not only the private flyer but will aid also the development of our air transport system and, of course, the manufacturers, as well.

It should be borne in mind that the automobile would never have achieved its present position in our social and business life, nor have become the rich revenue producer that it is to the states, had it not been for the development of good roads, interstate and intrastate.

The conclusion is inescapable that the interests of flying, as the new means of transport, and interests of the states, as the means for its development, are identical.



Airways in operation in the United States as of Aug. 1, 1931.

The economic aspects of transport plane design

By A. A. Gassner

Operators and designers are beginning to realize that airline profits or losses may be materially influenced in the earliest stages of airplane design. Planes must not only be able to fly, but to fly profitably under a given set of conditions. Mr. Gassner's authoritative study should be of interest to everyone concerned with the problem of making transport airplanes financially self-supporting

FOUR requirements have to be fulfilled to make air transportation interesting to the general public: (1) speed must be appreciably higher than that offered by competitive ground transportation, (2) cost must be the same or only slightly higher, (3) reliability and dependability must be proven, and (4) a high grade of safety must be assured. The first two requirements have the most direct influence on the financial possibility of air transportation, for no mere reputation for reliability and safety will make the public use planes if speed and price are not right. In this study the factors which determine the transportation cost for present day airplanes together with the basic limitations for plane design characteristics and airplane operation with reference to their influence on transportation cost will be analysed.

$$C_{PM} = C_{HP} \times \frac{W_{PA} \times hp.}{W_{PL} \times V \times f} \quad (1)$$

C_{PM} = transportation cost in cents per passenger-mile (200 lb. per mile);

C_{HP} = operation cost of the plane in regular airline service per hp.-hr. in cents.

W_{PA} = weight of passenger with baggage in pounds, (usually taken as 200 lb.).

$hp.$ = nominal rated hp. of the engine, or engines.

W_{PL} = payload in pounds

V = cruising speed of the plane, (in this study taken as the speed obtained with full load with engines running at 85 per cent of the r.p.m. at rated hp.).

f = loading factor, obtained by dividing number of actually used seats by number of totally available seats.

The transportation factor

Equation 1 has been set up for the purpose of making more easily visible the rôle these factors are playing in the determination of cost of transporting a given weight unit. It is evident that the operation cost per hp.-hr. is directly proportional to transportation cost per passenger-mile and that engine hp. affects it in direct proportion, assuming useful load and speed remain unchanged. Weight of passenger and baggage or of other items of useful load also affect the cost per unit weight-mile in direct proportion to their increase or decrease. For instance, if the airplane has a payload of 600 lb. and the weight of passenger plus baggage is 200 lb. in one case and 150 lb. in another, the number of passengers carried would be respectively four and three. Increase of payload decreases cost per passenger-mile in direct proportion. The same is true in the case of cruising speed, for if speed increases with useful load, operating cost per hp.-hr. and rated engine hp. remaining unchanged, the cost per passenger-mile decreases in direct proportion. It is obvious that the loading factor or, in other words, the percentage of utilization, has influence on the cost per passenger-mile; thus, fewer seats occupied, higher the cost of transporting the available passengers.

Further,

$$W_{PL} = W_{UL} - W_F \quad (2)$$

where W_{UL} = useful load and W_F = fuel load. The useful load is the weight which remains when the weights of the empty plane, the crew, oil, and equipment are deducted from the gross weight of the plane. In many published specifications of commercial transport planes the term "useful load" is misleading, as it is given as the difference between gross weight and weight of the empty plane, but from an airline operator's point of view, the above is the only correct definition. Few manufacturers include the weight of radio, or of other special electrical equipment in the weight of the empty plane.

The required fuel load can be calculated from equation

$$W_F = \frac{F \times R \times hp.}{V} \quad (3)$$

where F = specific fuel consumption at cruising r.p.m. in lb. per hp.-hr. based on rated hp., and R is the expected cruising range in miles. The factor F is nearly the same for all commercial engines and amounts to 0.3 lb. per hp.-hr. It represents the total actual fuel consumed at cruising r.p.m. in pounds, divided by rated maximum engine hp. This method of determining the fuel consumption factor has been chosen because the equations are based on rated engine hp., and the fuel consumption at cruising r.p.m. (approximately 63 per cent of maximum engine hp.), must be brought in relation to rated hp. Table I gives

the calculation of this value for a number of current engines.

Combining Equations 2 and 3

$$\frac{W_{PL}}{hp.} = \frac{W_{UL}}{hp.} - \frac{F \times R}{V} \qquad (4)$$

From Equations 1 and 4 the transportation cost per passenger-mile becomes

$$C_{PM} = C_{hp} \times \frac{W_{PA}}{\left(V \frac{W_{UL}}{hp.} - FR\right) \times f} \qquad (5)$$

Composition of total cost

The cost per passenger-mile increases, therefore, with increase of operating cost per hp.-hr., with increase of weight of passenger and baggage, with increase of specific fuel consumption of the engine, and with increase of the range of the plane. It decreases with increase of the loading factor, with increase of useful load per rated hp., and with increase of cruising speed, if such increase of speed is obtained without increase of power. In the transportation cost formula all of the factors are very easily obtainable with the exception of the operating cost per hp.-hr.

The operating cost per hp.-hr. is greatly influenced by the number of hours the plane is in actual use per year. The more hours planes are kept in the air, the lower is the relative personnel and organization expenses. For this study it will be assumed that the plane is flying 1,200 hours per year, that is, an average of 3.3 hours per day. Records of actual airline operation show that this figure is a fair average. Two further basic assumptions are that the life of the plane without engines is 3,000 hours and that the life of the engine is 1,500 hours. These figures include, of course, the total life of equipment with minor and major overhauls. It might be questioned whether an engine life of 1,500 hours is not too conservative, but current records indicate that this figure comes close to actual operating experience. It is not difficult to rework the operating cost figures for any other basic assumptions if special conditions should make this desirable.

The sales price of American transport planes without engines is now approximately $30 per nominal engine hp. The price of American commercial airplane engines is approximately $12 per rated hp. Both values are averages, and the following calculations have been carried out also for a price reduction of 10 per cent and of 20 per cent for planes and engines. The cost of maintenance and repairs, including minor and major overhauls, is taken as 0.4 cents per hp.-hr. for the plane without engine, and as 0.5 cents per hp.-hr. for the engine.

Based on above assumptions, the depreciation and maintenance expenses are calculated as follows: At a basic price of the plane without engine of $30 per rated hp. and with life of the plane of 3,000 hours, the depreciation cost per hp.-hr. is 1.0 cent. At a basic price of the engine of $12 per rated hp. and with an engine life of 1,500 hours, the depreciation of the engine is 0.80 cent per hp.-hr. For a 400-hp. engine this would give a price of $4,800 and a depreciation of $3.20 per hour. The cost of maintenance and repair for this engine would be $2.00 per hour.

Table I: Fuel consumption at cruising speed

	At rated r.p.m. and hp.				At cruising r.p.m. (85 per cent of rated r.p.m.)				
	Hp.	R.p.m.	Fuel consumption, lb. per hp. per hour	Total fuel consumption per hour	Hp.	R.p.m.	Fuel consumption per hp. per hour.	Total fuel consumption per hour	Fuel consumption at cruising r.p.m. in lb. per hp.-hr. of rated hp.
Wasp C...	425	2000	.54	230	270	1700	.46	124	.292
Hornet B..	575	1950	.55	317	360	1660	.48	173	.301
Wasp Jr...	300	2000	.54	162	190	1700	.48	91	.305
Wright J-6	320	2000	.50	160	200	1700	.49	98	.306
Conqueror	630	2450	.535	337	410	2080	.49	200	.318

The insurance premium for a complete airplane for airline operation is approximately 12 per cent of the plane's value, per year. For a basic sales price of $42, the insurance cost is $5.04 per year and rated hp., or 0.42 cent per hp.-hr.

To enable the operator to make regular inspections, periodic overhauls, minor repairs, and adjustments reserve planes and engines have to be maintained by the line to prevent interruption of the operation schedule. Consider this reserve to be one plane and the proportionate number of engines to each four machines in actual flying service. One-fourth the depreciation of the spares must be borne by each active plane. Depreciation of planes and engines goes on also when the equipment is not in flight, partly on account of deterioration by weather, and, to a greater extent, by obsolescence.

As determined above, the fuel consumption is 0.3 lb. of gasoline per rated hp.-hr. With a price of gasoline of 15 cents per gal. (6 lb.), the fuel cost is 0.75 cent per hp.-hr. Oil consumption is taken at 0.02 lb. per hp.-hr., again based on rated hp. At a price of aviation engine oil of 60 cents per gal. (7.5 lb.), the cost of lubricating oil is 0.16 cent per hp.-hr. This figure takes into consideration actual use of lubricating oil and waste of oil occurring by the regular draining of the engine crankcase.

Pilot's salary and traveling expenses amount to $6,500 per year, which gives, for 1,200 flying hours per year, an expense of $5.42 per flying hour. Assistant pilot's salary and expenses are taken at $4,000 per year, or at $3.33 per flying hour. Pilot and co-pilot each are insured for a sum of $20,000, for which insurance the premium is approximately $500 per year for each, or $0.41 for each per flying hour. Since all calculations are based on the term of hp.-hr. which method gives very simple and useful formulas, a relation must be established for crew's salaries and expenses per hp.-hr. It is of course a simple fact that a plane equipped with a 300-hp. engine needs only one pilot, as does one with a 600-hp. engine. Larger machines have to carry two pilots (one of which acts also as radio operator), and on many of the big airliners, stewards are provided for the convenience and comfort of the passengers. In Table II the expenses have been calculated for the crew for five planes of varying size. The assumption is, (1) that single-engined airplanes up to about 500 or 600 hp. carry only one pilot, (2) that multi-engined planes up to around 1,500 or 1,600 hp. carry pilot and co-pilot, and (3) that the largest airliners have a crew of three men.

The average of the values of Table II is 1.074 cents for crew's expenses per hp.-hr. This value is 48.5 per cent below that for the 300-hp. single-engined plane, and 50 per cent above the value for the 2,000-hp. multi-engined plane. Comparatively few of these types are used, however, on airlines in this country, as most of the equipment is of the 400- or 500-hp. single-engined type, or of the 1,000 to 1,250-hp. multi-engined class. An average value of 1.0 cent per hp.-hr. seems appro-

Table II: Expenses for crew

	Single-engined 300-hp. plane	Single-engined 500-hp. plane	Multi-engined 1000-hp. plane	Multi-engined 1500-hp. plane	Multi-engined 2000-hp. plane
Pilot's salary in dollars, per flying hour	5.42	5.42	5.42	5.42	5.42
Co-pilot's salary per flying hour	....	....	3.33	3.33	6.66
Pilot's and assistant's insurance per flying hour	.41	.41	.82	.82	1.23
Total expenses in dollars, per flying hour	5.83	5.83	9.57	9.57	13.31
Total expenses in cents, per hp.-hr.	1.943	1.166	.957	.637	.666

Table III: Operating cost in cents per hp.-hr.

	A	B	C
Basic price in dollars per rated hp....	42.00	37.80	33.60
Depreciation of plane without engine..	1.00	.90	.80
Maintenance of plane without engine..	.40	.40	.40
Depreciation of engine.....	.80	.72	.64
Maintenance of engine.....	.50	.50	.50
Depreciation of reserve plane.....	.25	.225	.20
Depreciation of reserve engine.....	.20	.18	.16
Insurance plane and engine.....	.42	.378	.336
Fuel expenses.....	.75	.75	.75
Lubrication expenses.....	.16	.16	.16
Flying personnel expenses.....	1.00	1.00	1.00
Hangar expenses.....	.30	.30	.30
Total (cents).....	5.78	5.513	5.246
Overhead (20 per cent of above total)	1.156	1.103	1.049
Operating cost per hp.-hr. (cents).....	6.936	6.616	6.295

Table IV: Percentages on operating cost

Basic price of plane per hp.	$42.00		$37.80		$33.60	
	Cents	Per cent	Cents	Per cent	Cents	Per cent
Depreciation, maintenance and insurance*.....	3.57	51.45	3.303	50.00	3.036	48.20
Fuel and oil expenses.....	.91	13.15	.910	13.75	.910	14.48
Flying personnel expenses.	1.00	14.42	1.000	15.10	1.000	15.90
Hangar rent.....	.30	4.330	.300	4.50	.300	4.77
Administrative expenses..	1.156	16.65	1.103	16.65	1.049	16.65
Operating cost per hp.-hr.	6.936	.....	6.616	.....	6.295	.....
Saving, compared to A....	.....	.....	.320	4.60	.641	9.70
Saving, compared to B....	.....	.....	.....	.....	.321	4.80

* Of planes, engines, reserve planes and reserve engines.

priate for use in calculations for the crew's expenses. As will be shown later, this item has only moderate influence on the operating cost per hp.-hr., and slight variations can be neglected.

Another expense factor to be considered in the cost calculation is the hangar charge. It appears to be difficult to make evaluations for such expenses based on hp.-hr. because it may seem at first glance that they are not dependent on engine hp. but rather on overall dimensions or gross weight of the plane. The gross weight of modern transport planes bears a certain relationship to the engine power, since power loadings for most transport planes vary within comparatively close limits, being in the majority of cases above 10 and below 15 lb. per hp. The wing area, and therefore the overall dimensions of a conventional plane are also rather closely related to the gross weight, and thereby to the power loading. Most transport planes have wing loadings below 17.5 and above 14 lb. per sq.ft. The cost of hangar space can then be calculated in terms of hp. and the possible error is negligible because in actual operation the differentiation for hangar cost in relation to the size of the plane is made in wide steps. Assume hangar charge at $8 per day for each 1,000 hp. of the plane, which gives with 4,800 flying hours for five planes a cost of 0.30 cent per hp.-hr.

Overhead for administrative and office expenses, for cost of ticket selling, and for advertising is, of course, a variable. These expenses are substantially independent of small changes of power, but as stated previously, size and capacity of the plane are dependent within close limits on the available engine power. Expenses of the ground organization for passenger comfort and for handling of useful and of fuel load increase with engine power and with size of the equipment. Allow for all operation overhead expenses a sum of 20 per cent of the total of all previously stipulated costs, which is equivalent to 16.65 per cent of the total operating expense per hp.-hr.

Table III gives a calculation of operating expenses per hp.-hr. for three basic prices of airplane, and Table IV shows the percentages of various items on the total operating cost per hp.-hr.

Calculating costs

In Fig. 1 has been plotted the curve of operating expense per hp.-hr. against basic price of plane per rated hp. It will now be seen that this method of calculating transportation cost on a basis of operating cost per hp.-hr. is very convenient and simple, because the size of the plane and the number of engines are eliminated as a factor in figuring the cost. The figures of Table III and the curve of Fig. 1 may have to be modified occasionally to take care of specific conditions of operation, especially as to cost of maintenance and general overhead percentage. The aerodynamic and weight characteristics of the machine come into the picture, however, when the transportation cost per passenger-mile has been determined.

Table V, which gives the percentages of various items of the operation cost, shows some very interesting facts. It is apparent that a reduction of the basic price influences the operating expenses to a great degree. If the initial cost of the plane with engine is reduced by 10 per cent, the operating cost is reduced by 4.6 per cent. This is explained by the fact that depreciation and maintenance expenses for plane and engine make up approximately one-half of the total operating cost. One of the most essential requirements to make plane operation more economical is therefore reduction of first cost, and of rate of depreciation. From Table III it can be seen that depreciation of plane and engine for type *A* amounts to 1.80 cents per hp.-hr. If the useful life of plane and engine are both increased by 50 per cent (which gives for the plane without engine a life period of 4,500 hours and for the engine 2,250 hours), the depreciation is decreased by one-third, or by 0.60 cent per hp.-hr. The operating cost of this plane of a basic price of $42 is thereby reduced from 6.936 cents to 6.336 cents, or by 8.66 per cent. From Fig. 1 an operating cost of 6.33 cents corresponds to a basic sales price of $34.10. This means that in the case here analyzed, the increase in life of 50 per cent is equivalent in its effect on operating cost to reduction of the basic price by 18.8 per cent. The best solution would of course be to combine these two measures, to reduce the price and to increase simultaneously the life period of the equipment.

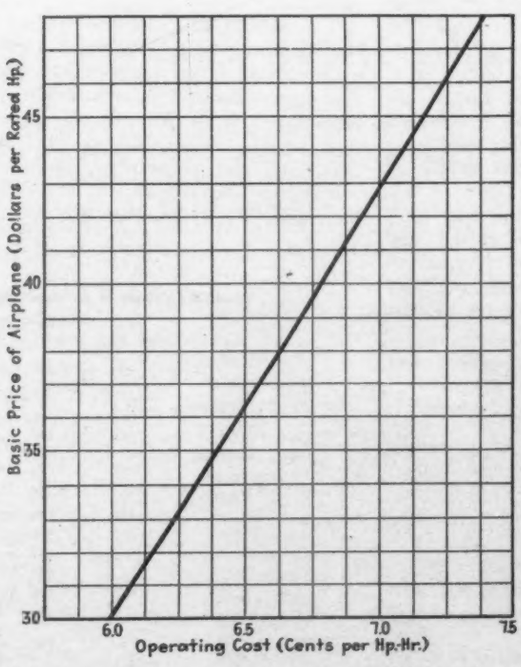


Fig. 1: Operating cost per hp.-hr., based on basic price of airplane per rated hp.

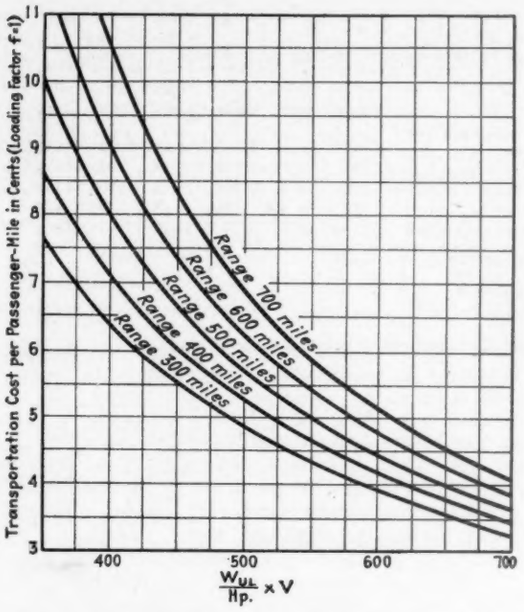


Fig. 2: Transportation cost per passenger-mile (200 lb. per mile) on an operating cost per hp.-hr. of 10 cents. Note: To find actual transportation cost, multiply values obtained from this figure by one-tenth of actual operating cost per hp.-hr. (See Fig. 1).

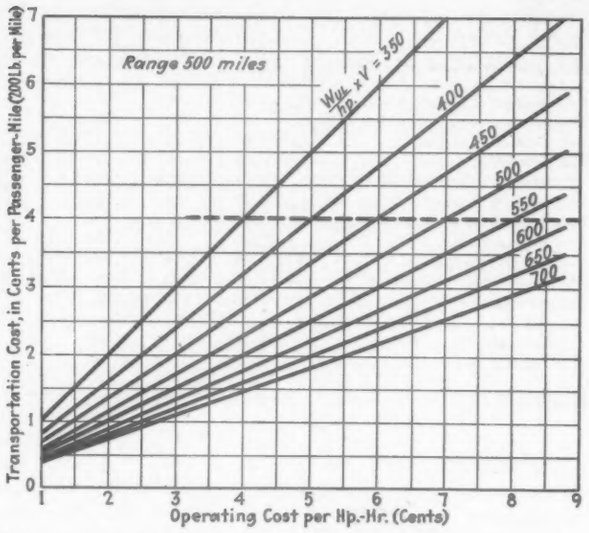


Fig. 3: Transportation cost per passenger-mile for various values of transportation coefficient and basic operating cost.

A few examples will serve to illustrate the use of Fig. 1. Consider a single-engined plane of 400 hp., which sells for $16,000, that is, for $40 per rated hp. Under the above assumptions, take the value for operating cost direct from Fig. 1. This is found to be 6.80 cents per hp.-hr., which means that the operating cost of this plane will be $27.20 per hour. If it has a cruising speed of 120 m.p.h., the operating cost per mile is 22.67 cents. If a tri-engined plane of 1,200 hp. costs $50,000, the cost per rated hp. is $41.66 and the operating cost is 6.925 cents per hp.-hr., or $83.10 per hour.

Since the operating cost factor has been evaluated it is possible to proceed with the investigation of the remaining part of Equation 5. If the weight of passenger and baggage is taken as 200 lb., the factor F of specific fuel consumption at cruising speed as 0.3, and assuming a loading factor f equal to one, (which means that all available seats are used and paid for), Equation 5 becomes

$$C_{PM} = C_{HP} \times \frac{200}{\left(\frac{W_{UL}}{hp.} \times V\right) - 0.3\ R} \qquad (6)$$

In this equation all factors are known except two. The range R is usually determined by the wishes of the operator and is one of the characteristics of air transportation which influences cost to a very large degree. The other factor can and must be influenced by the airplane designer; this is the term $\frac{W_{UL}}{hp.} \times V$ which has been here named the transportation coefficient. It is the only factor in this formula which the designer can alter materially by increasing the efficiency of the machine as far as the weight and the aerodynamic qualities are concerned. Since this factor is on the lower side of the fraction it must be increased to decrease the transportation cost. This can be achieved (1) by decreasing the weight of the empty, but fully equipped airplane, (2) by increasing the gross weight and thereby the useful load, (3) by increasing the cruising speed without increasing the engine hp., or (4) by decreasing engine power without change in useful load and cruising speed. All these methods can, of course, be combined to increase the transportation factor.

To obtain an average value, the transportation factor has been calculated for a number of typical transport planes. The figures for speeds and weights have been taken from AVIATION's specification tables. According to the above definition, the term W_{UL} as used in calculating the transportation factor is the sum of actual payload and fuel load. Weight of crew and lubricating oil is not considered part of useful load, but as part of the weight of the plane. If radio, or other special equipment is carried, its weight has to be considered as dead weight also and has to be deducted from either the fuel or payload.

Table VI shows the values of transportation cost per passenger-mile in cents, as related to transportation factor

$$\frac{W_{UL}}{hp.} \times V$$

and the range of the airplane. The value for operating cost per hp.-hr. used in this table is 10 cents. This makes it possible to take the values of transportation cost from this table, or from the curves of Fig. 2, and to multiply them by one-tenth of the actual operating cost per hp.-hr. (which can be taken from Fig. 1 for the specific machine under investigation), to obtain actual transportation cost per passenger-mile for any given range. The transportation factor has to be calculated, of course, from available information, taking care to use only

Table V: Values of transportation factor for typical transport planes

500-mile range at cruising speed

Calculations are based on data in AVIATION'S *specification tables*

	Ford 5-AT-C	Sikorsky S-38	Curtiss Condor	Lockheed Vega 5-B	Bellanca Airbus	Boeing Monomail 221	Stinson Tri-motor
Rated hp	1,260	840	1,200	420	600	575	645
Maximum speed	152	128	.....	180	147	158	140
Cruising speed	122	110	116	150	125	137	115
Weight empty	7,600	6,650	11,352	2,595	5,490	4,990	5,475
Crew	340	340	340	170	170	170	170
Oil	270	200	225	90	110	110	110
Fuel load	1,647	1,440	1,861	545	1,158	800	720
Payload	3,643	1,900	3,600	1,200	2,572	1,930	2,022
Useful load	5,900	3,880	6,026	2,005	4,010	3,010	3,125
Gross weight	13,500	10,430	17,378	4,500	9,500	8,000	8,600
W_{UL}†	5,290	3,340	5,461	1,745	3,730	2,730	2,740
$\frac{W_{UL}}{hp.} \times V$‡	512	437	528	622	777	649	488

†Fuel load and payload. ‡Transportation facts.

such value for W_{UL} as is stipulated in previous paragraphs. The loading factor f in both Table VI and Fig. 2 is assumed to be unity, that is, all seats are used and paid for. The weight of each passenger and his baggage is taken at 200 lb.

Table VI: Transportation cost per passenger-mile

Calculated with operation cost per hp.-hr. of 10 cents

$\frac{W_{UL}}{hp.} \times V$	Range in miles				
	300	400	500	600	700
350	7.68	8.68	10.00	11.78	14.30
400	6.44	7.13	8.00	9.08	10.52
450	5.55	6.05	6.66	7.40	8.33
500	4.87	5.26	5.72	6.24	6.89
550	4.34	4.65	5.00	5.40	5.88
600	3.92	4.16	4.44	4.76	5.12
650	3.57	3.77	4.00	4.26	4.54
700	3.28	3.45	3.64	3.84	4.08

Fig. 2 shows some exceedingly interesting facts which have great importance for commercial aviation, for it affords some visualisation of the interrelation between aerodynamic and weight characteristics of the plane, the range as required by the airline operator, and the transportation cost per passenger-mile. It can be seen that only close coordination of all factors will bring lower transportation cost.

Range has a greater influence on transportation cost than is usually recognized, especially for planes of low and medium efficiency, that is, for those with a low transportation factor. An increase of range from 300 to 600 miles increases transportation cost per passenger-mile by 21.5 per cent for a machine with a transportation factor of 600, and by 41 per cent for one with a factor of 400. Percentages for other cases can be easily figured from Fig. 2. For average airline operation a range of 500 miles between refueling should be amply sufficient. To have the necessary margin of fuel to take care of head winds or detours on account of weather difficulties, the maximum distance flown between refueling points should then not be more than 400 miles.

A practical example

A sample calculation of operation cost, transportation cost and factor, showing the influence of range, for a typical airplane equipped with an engine of 420 hp. follows. The weight empty is 2,500 lb., its gross weight 4,500 lb., and its cruising speed 140 m.p.h. The weight of pilot is 170 lb., that of the lubricating oil 90 lb., and the weight of miscellaneous equipment is 120 lb. The useful load (as stipulated in this study) is therefore 1,620 lb., which includes actual available payload and fuel load at take-off. The transportation factor

$$\frac{W_{UL}}{hp.} \times V = \frac{1620}{420} \times 140 = 540.$$

If we assume for this plane a sales price of $16,000, or a basic sales price of $38.10 per rated hp., the operating cost per hp.-hr. as given on Fig. 1 is 6.645 cents. From Fig. 2 the transportation cost per passenger-mile is found by multiplying the values of ordinate of

$$\frac{W_{UL}}{hp.} \times V = 540$$

by 0.6645. This gives the following results: range 300 miles—transportation cost per passenger-mile 2.96 cents; range 400 miles—3.16 cents; range 500 miles—3.42 cents; range 600 miles—3.69 cents.

Assume now an increase of cruising speed of this plane by 10 per cent to 154 m.p.h., without changing hp. or weight. The transportation factor becomes then

$$\frac{1620}{420} \times 154 = 594$$

and with same basic price as above the transportation cost for a range of 500 miles now becomes $4.5 \times 0.6645 = 2.99$ cents, as compared to the previous 3.42 cents, which constitutes a saving of 12.6 per cent. The effect of reduction of weight of the empty plane, of increase of gross weight, of increase or reduction of engine power, or of first cost can be evaluated in samiliar manner. This makes the method very useful for determining whether increase of speed, obtained at increased sales price, or of weight empty, is economically advantageous.

Finally Fig. 3 shows the values of transportation cost per passenger-mile for various values of transportation coefficient and operating cost per hp.-hr. Since air transport operation can never count on a constant loading of 100 per cent, it must be stipulated that a transportation cost of 4.0 cents per passenger-mile is about the highest possible limit. At a ticket sales price of 8.0 cents per mile operating expenses would be covered with a loading of 50 per cent, or with an average of one-half of all available seats sold. All combinations of operating cost and transportation factor below the line of transportation cost of 4.0 cents will give planes which make such operation possible.

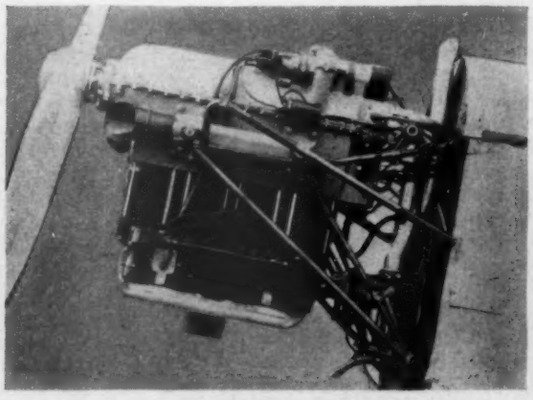
It is not possible to give in this study positive answer to the question as to whether or not the transport plane in general can support itself financially. The closely interconected problems of airline efficiency, cost and useful life of plane and engine, aerodynamic and weight characteristics and perfomance of the plane, of range requirements of the operator and of fuel consumption of the engine must all be considered more or less simultaneously. The intention has been only to furnish a comparatively simple way for attacking these problems, to assist the investigator of specific cases.

It is obvious from the above discussion that there must be close cooperation between airplane and engine manufacturer and the airline operator if commercial air transport is to be put on an economically sound basis.

o

A German light plane engine

AN inverted four-cylinder, in-line, air-cooled engine for light airplanes has been designed and built by Mr. Hellmuth Hirth, one of the oldest pilots in Germany. The engine which is rated at 65 hp. at 2,100 r.p.m., is similar in appearance to well-known British and American engines of the same type, but involves a number of interesting and novel features. Smoothness of operation is gained by a full use of special ball and roller bearings, and by special intake manifolding to insure uniform distribution of fuel to all cylinders. The firing order and valve timing is unconventional as a crankshaft of new design patented by Dr. Albert Hirth is employed. The combination of all factors is said to result in exceptional smoothness of operation at all engine speeds.



The Hirth engine

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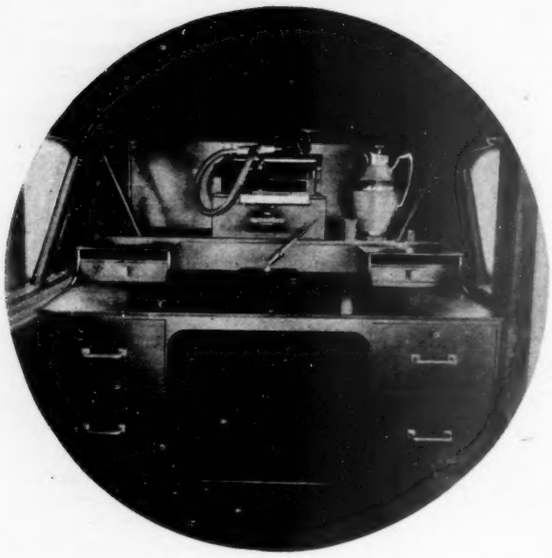


By Douglas W. Clephane

Selling the business plane

The present depression is forcing executives in all branches of business to a realization of the need for closer contact in their fields of activity. This can be accomplished most efficiently by airplane. In the accompanying article the author discusses this and other phases of the business market and analyzes some three hundred sales of airplanes made to business men.

AS BUSINESS strikes the upgrade there will be an intensive effort on the part of all airplane manufacturers, and dealers and distributors, to reach the large potential market for planes among non-aeronautical corporations. Over 300 planes have already gone to such buyers, but the amount of business expected has failed to develop, not only because of the general business depression, but because the industry as a whole has not been able to sell the fact that ownership of an airplane by a large company will result in a very definite time and money saving, a tremendous increase in prestige, and an indirect advertising and publicity value.

The coming months offer a more promising opportunity for well-directed sales efforts in this direction, for during the last year executives of the largest companies, from the president on down, have been out in the field more than ever before, and are ripe to consider any proposal that will permit more frequent field contracts over a wider area.

Before summarizing the experience of the writer in hundreds of contacts with corporation executives in selling privately owned airplane transportation, a breakdown of an incomplete list of 300 companies who have purchased their own planes should prove illuminating. Despite the inadequacy of available information, the percentages on page 590 show the fields in which the corporation owned airplane has proven of greatest value, and the type of companies that own the largest number of planes.

The oil companies have purchased by far the largest number of planes when classified by industries, and only a small proportion of them are used directly in promoting the sale of aviation gasoline. The airplane has afforded greatest usefulness in making surveys, transporting crews and replacement parts, and general transportation service. Next in volume come lumber, paper, mining, power and other companies engaged in making raw materials marketable, and requiring surveys of territory hard to reach by ground transportation.

Probably the greatest potential market for planes is among the thousands of companies that do a large volume of business in small units requiring thousands of retail outlets, tremendous expenditures to keep the name of the product before the public, and close contact with both sources of supply and the distributing organization. This classification includes companies making and selling food products, cigarettes, chewing gum, medical and drug supplies, polish, office supplies, paint, clothing, and other such products. This field has absorbed about a tenth of the present planes now being used purely for business, and is one in which the airplane has proven of greatest value.

Organizations producing expensive machinery, or having need of frequent personal contact with, and service work by, highly paid specialists, have found the privately owned airplane many times an essential instrument. Huge organizations such as General Electric and American Telephone and Telegraph have purchased their quota of planes both for experimental purposes, and for general executive transportation use. A few chain stores with their thousands of units in all parts of the country have experimented with the use of airplanes,

but the use there has not been as widespread or as successful as would be expected.

Quite a number of newspapers now own their own planes, and many more are experimenting with air delivery of papers to nearby towns in chartered planes. A few publishing firms have found the ownership of their own plane a profitable investment, but the number of large organizations of this character is quite limited. A few banks, investment houses, and insurance companies have purchased their own planes, for use in transporting money and securities, sales work, and contacts with important clients, but the trips are usually not over a long enough distance to show a great saving in time, and it is expected that regular service will be established by the airlines for transportation of money and securities.

Another of the largest potential fields for business sales is professional men, such as lawyers, doctors, writers, architects, and capitalists who have to make frequent long business trips.

Future purchasers

A detailed survey of future sales of planes for business use leads to the forecast that corporations in the above listed fields will purchase nearly all the airplanes bought for private use in the next few years. Airplane manufacturers, dealers and distributors have made little attempt at a detailed market analysis of the possibilities of sales for business use, and the mapping out of a detailed sales program to reach each type of business, such as would have been employed in any other industry.

Having determined through past experience where our market lies, to some extent at least, the next problem is how to reach it. Each of the twelve listed fields will require a different type of approach, and different data. Lists can be made up from trade directories, and many other sources, or compiled by list houses, of the largest companies in each field. In general, the larger corporations are the best prospects, although care must be taken not to overlook the smaller, and sometimes more progressive organizations.

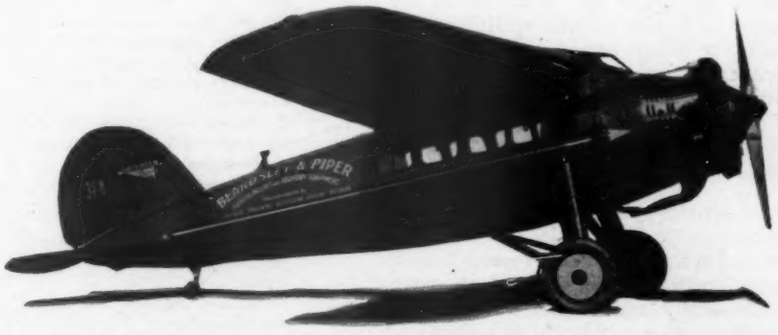
One of the most interesting things to note in selling business transportation, is the fact that executives of practically all the large corporations will answer any personal letter concerning the purchase of a plane. They are somewhat flattered to be singled out for such a communication, they jump at the chance to obtain accurate information, and often will go into detail by mail concerning their transportation problems and what they would like to know.

Planned procedure

Having determined who the individual prospects are, preparations must be made to approach each one of them in a manner to bring results. In the past many salesmen have attempted to sell airplanes as they would a filing cabinet, going in without knowledge of the proper parties to see, with no information as to the activities of the company, or how it might employ a plane. Too many times when some official declared he was not interested, the matter ended there. Facts concerning past corporation sales prove that it takes an average of eighteen months from the time the matter of a plane purchase is first brought up to the actual signing of an order. Many sales have been made after constant contact over a period of from three to five years, but with a product selling for from $4,000 to $50,000 a comparatively large sales expenditure is warranted.

Having decided that a certain company could use a plane, the sales office should map out a definite plan of procedure for each individual prospect. The first step is to find out who within the organization is interested in aviation. Possibly this party will be the assistant sales manager, assistant to the vice-president, the son of some official, or a minor executive, who has no authority to make an actual purchase. When such a person is found, he will often work as hard as the salesman himself to bring about the purchase. From him, detailed information can be obtained as to who has the authority to recommend the purchase, information as to who travels, where and how much, and general data as to the internal organization of the company, and the objections of various executives to flying. This is an essential part of any sale, and seldom should any important official be approached until this information is obtained.

Corporation executives tell us that, while they have been approached many times to buy a plane, it is almost impossible to obtain any accurate unbiased understandable information concerning its usefulness in business. The average man wants to know if flying is safe, whether his insurance would be paid if he were killed or injured in an airplane accident, how much it costs to operate a plane, whether he could land at his summer home, why some planes have one engine and others three, how long it would take him to contact his branch offices in ten cities with an airplane at his disposal, and how other



Manufacturers of machinery and factory installations have found the airplane almost a necessity to enable high-salaried engineers and other officials to make the many contacts required in all parts of the country. The Beardsley and Piper Company, has recently purchased its second Lockheed.

Robbins

J. H. McDuffee, general manager of the Prest-O-Lite Battery Company has traveled over 70,000 miles in his plane, contacting dealers and all parts of his nation-wide organization.

companies with an organization similar to his use their planes.

The salesman should devote his entire efforts in the first calls on a prospect to selling him on the idea that he can use a plane, and leave comparisons between different makes and types till later. He should be prepared with charts showing comparative railroad and airplane time between principal points, written tabulated data on cost of operation, detailed data on how other corporations are using their planes with statements of their value from high officials, all available information concerning the safety of flying, data on the effect of flying on personal insurance, good interior and exterior photographs preferably showing prominent business men with their planes, and lastly should be prepared with a plan of operation for the particular prospect. The sales office should immediately follow the salesman's visit with a letter thanking the executive for the interview, and taking up points in which the prospect is interested.

Seldom can a comporation sale be effected by selling one man. Usually the president, vice-president, sales and advertising managers, the entire board of directors, and in general all those who might use a plane have to be convinced of its value and safety before an order is placed. Few corporations will demand that an employe fly if he is disinclined to do so or if his family raises strong objections. The salesman should be careful not to try to do too much in a single call, realizing that from five to ten personal contacts with each executive will be required before they will even give serious consideration to such a purchase.

An advertised product

Advertising plays an important part in the corporation sale. While few direct inquiries may be received as a result, the executive will believe more in the safety and usfulness of a plane whose name he constantly sees, than one made by a company that relies almost entirely on personal contacts. The writer has been able to trace three sales of expensive planes in a three-month period directly to trade paper and business magazine advertising.

It must be remembered that the danger of flying will usually be the executive's greatest objection to the purchase of a plane. Often this will not be expressed, but the salesman must always tactfully present all available information on the safety of flying. The families of executives often furnish the stumbling block to the consummation of a sale, but this is another sales resistance that will seldom be expressed. Every effort should be made to convince the wives and families of executives that flying is safe, and they should be included in the demonstrations.

Many a sale has been lost through not using proper technique in giving demonstrations. The plane should always be freshly cleaned both inside and out, it should be warmed up waiting for the arrival of the prospect at the airport, and only the most conservative flying should be done during such a demonstration. Many pilots attempt to show the stunting qualities of their machine, but this will only increase the fear resistance of the prospect unless he has had a great deal of experience in flying. A warm day should be selected if possible, and the prospect will always remember a trip over his home or factory. The most practical demonstration is to take the prospect on one of his regular business trips. This costs money, and many dealers will not do it until the prospect has definitely stated that he is ready to buy, but it is well worth while. Often the younger contact man within the organization itself, will tip the salesman off when the president has a rush trip, or has an urgent shipment of merchandise to make. The writer has seen four sales closed as a direct result of the salesman taking the executive on a trip lasting from four to seven days, when the executive stated that he doubted if he was really interested. During such a trip, the prospect has an opportunity to see for himself the prestige which arrival in a plane gives him, he can compare the saving in time and, most important, he will be in a frame of mind sometime during the trip for a serious discussion of the plane's possibilities for his own organization. Such an opportunity can seldom be obtained during an office interview or short demonstration.

Breakdown, in per cent, of some 300 corporation owned planes by types of companies.

1. Oil companies	20
2. Companies doing a large business in small unit sales	11
3. Professional and private business use	10
4. Lumber, paper, power, mining, and other companies for aerial survey and transportation use	10
5. Machinery and building material companies	9
6. Companies making products for use in the aviation field, excluding oil companies	8
7. Large corporations for experimental work and executive transportation	6
8. Real estate sales and development companies	5
9. Publishing companies	4
10. Investment, banking and insurance companies	4
11. Newspapers	3
12. Chain stores	2
13. Miscellaneous	8

Every other industry has learned that it is the poorest sort of salesmanship to knock a competitor's product, but we still have much of this. If the salesman says his competitor's plane is unsafe, or points out instances where planes cracked up due to faulty construction or design, he is doing the best thing in the world to kill any sale. The prospect will feel that if there are planes that are so dangerous, he would rather wait until airplane design in general has reached the point where all planes are safe.

Making the executive choose

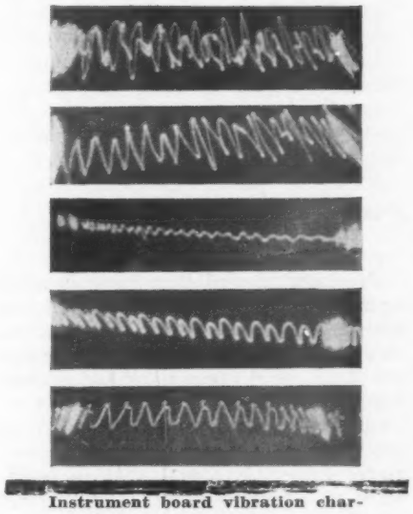
We hear on every side that a pilot usually has the final say in the selection of a plane, and that a commission is often necessary to outside parties to bring about the final order. This has unfortunately been true, but is largely the result of too technical a discussion with the executive, and of not getting him to understand comparative points himself. The writer has found that when the above outlined procedure is followed, the prospect usually feels that he is a capable judge, and while he may ask outside advice he will reserve final decision for himself and associates.

There are many aids to office contact work which are generally employed in other types of sales work, but which the aviation industry has not as yet used. It would be well worth while to equip the corporation salesman with a portable motion picture projection machine, with specially prepared films to make a graphic presentation of construction features, safety information, comparative charts, use of planes in business, transportation of merchandise, and other points which can only be brought out inadequately in a discussion. Copies of articles, addresses, or letters from companies using planes, will be read with great interest by the average executive. Reprints of advertisements can be mailed with advantage, and lastly the salesman, whether connected with the factory or a dealer, should have a complete sales manual showing photographs, and giving accurate data for reference on any point which the prospect may bring up.

Last year all executives were engaged in closer contact with all parts of their organization and sales outlets, and have learned that more frequent contact must be maintained by the high-salaried office executive from the home office. Lack of time is usually the excuse given for not doing more of this work. Corporations are ready to be shown how the airplane can aid them in getting business, prestige, in delivering rush shipments, and general transportation, but the ground must be prepared first, and definite facts must be assembled, and the field men given proper material to work with, and trained in approaching this market. The manufacturer or distributor who goes after this market with intelligent sales analysis, proper sales promotion, and a judicious expenditure of money for direct results, should not have to complain of future business.

Revision of load factors and suppression of vibrations claim attention

Structural problems and the S. A. E.



Instrument board vibration characteristics on five planes, good, passable, and definitely bad.

THE Cleveland sessions of the Society of Automotive Engineers provided for only two papers on other than power plant subjects. Those two, however, proved to be so exhaustive and so packed with illustrations and demanded such careful presentation that even though the meeting continued until midnight there was time for only a small part of the discussion that members of the audience wished to contribute.

The first contribution, for which Stephen J. Zand of the Pioneer Instrument Company was responsible, was entitled "A Study of Airplane and Instrument Board Vibration." It presented the record of Mr. Zand's work in developing an instrument for measuring the vibration of any point in an airplane structure and his subsequent application of that instrument to an analysis of the vibrations of many points in a great number of airplanes, especially of the instrument boards,—the paper being based on a total of 216 such experiments.

Mr. Zand pointed out, what surely is not generally realized, that a very small error in even the simplest instrument may lead it to give totally false indications when mounted on a vibrating board. Nothing could be simpler, for instance, than the familiar bank indicator, consisting of a steel ball rolling in a curved tube filled with liquid, but when a group of such instruments of slightly varying forms were mounted on a board that was being vibrated with an amplitude of only 0.02-in. their readings fluctuated widely. Some of them continued to tell the truth, but others, on which the ball had too much or too little clearance in the tube, indicated angles of bank varying from the truth by as much as 10 deg. Similarly, when altimeters, the working parts of which had not been exactly balanced, were mounted on a similar vibrating stand, the needle fluttered so wildly as to be completely unreadable.

Instrument board vibrations

Mr. Zand pointed out that most vibratory troubles start from the engine, that the greatest care must be taken to avoid resonance of the natural periods of important parts of the structure and the periods forced by engine rotation, and that the engine mount and airplane structure should provide for the largest possible amount of damping. Flexible engine mounts, such as those incorporating rubber, serve the dual purpose of damping the vibrations and lengthening the natural periods so that resonance will appear at speeds below the normal speed of engine operation. The author had found, however, a marked difference of opinion on the usefulness of flexible mounts, the industry being about equally divided between those who thought that vibration could be reduced by making mounts more rigid and those who wanted to make them less rigid for the same purpose. Although vibration trouble ordinarily starts at the engine, the engine is by no means wholly responsible. Installation is a controlling factor.

The vibrograph developed by Mr. Zand and his associates has the general appearance and size of an altimeter and consists essentially of a free pendulum, the motions of which are optically recorded on moving picture film.

Trials on airplanes showed that in practically all cases the vibration of the instrument board is an almost pure fore-and-aft motion. In very few instances was the lateral motion of the board large enough to be taken seriously into account. It was discovered, also, confirming the expectation that the engine would be found the controlling factor, that the frequency of vibration of the instrument board was in practically all cases equal to the frequency of the engine rotation. Thus at 1,800 r.p.m. there would be 30 vibrations a second. The frequency was imposed entirely by engine speed, the natural period of the board having nothing to do with it. There was exception to this, however, when the vibration was measured at a point very remote from the engine, the frequency in the rear cockpit of a large plane being found to remain perfectly constant at 25 per sec. for all engine speeds.

As might have been expected, airplanes varied greatly in roughness, or in amplitude of vibration. Mr. Zand considered any amplitude up to 0.01-in. satisfactorily smooth, and that standard was attained by about half of the machines tested.

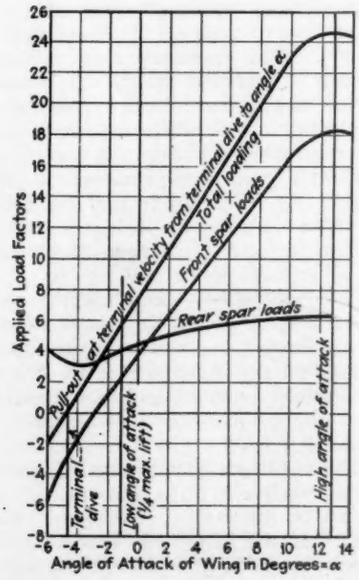
The amplitude of vibration of course varies widely with engine speed, as shown in the curves reproduced herewith. If the range of tests be sufficiently extended there are of course two maxima at speeds corresponding to the primary and secondary harmonics, respectively, the latter being at one-half

the r.p.m. of the former. In most cases the maximum amplitude does not exceed twice the minimum, but occasionally, when there is genuine resonance between the natural periods of several parts of the structure the ratio may run much higher than that. In one case (the curve is reproduced herewith), the vibration was so bad at 1,500 r.p.m. that the pilot was unwilling to fly the plane at that engine speed even long enough to make a measurement. Extension of the curve through the points taken just above and just below critical speed, however, suggested that the amplitude of motion of the instrument board would have been at least 0.03-in. Vibration amplitudes above 0.02-in. were classified by Mr. Zand as "extremely rough," causing headaches to the passengers and making the pointers of even well-balanced instruments oscillate $\frac{3}{8}$ in. or more.

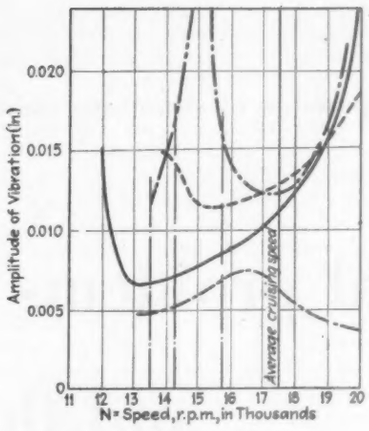
Another interesting series of experiments showed, quite surprisingly, that the vibration characteristics improve with age up to a certain point. In one case a brand-new machine showed a maximum amplitude 20 per cent larger than that of one of the same type after 50 hours service. In another case there was an almost identical difference between the curves for a new machine and for the same plane after 380 hours of flying.

As the result of these experiments the author announced the determination of his company to avoid any natural period or any natural frequency as between 1,000 and 2,000 per min. in all instruments designed in future.

In the course of the discussion, Mr. Doe of Eastern Air Transport recommended suspension of instrument boards between rubber shock cords in tension. Not only had his company found that


Applied Load Factors
Angle of Attack of Wing in Degrees = α
Pull-out at terminal velocity from terminal dive to angle α
Total loading
Front spar loads
Rear spar loads
Terminal dive
Low angle of attack (1/4 max. lift)
High angle of attack

Ultimate load factors, and spar loads, in pulling a pursuit plane from a dive.



Vibration curves, of varied form, for a few airplanes.

an admirable means of reducing instrument troubles due to vibration, he said, but even in major crashes instruments so mounted have sometimes been undamaged when hardly anything else was left of the plane.

Load factors rationalized

Prof. Joseph S. Newell of the Massachusetts Institute of Technology discussed the much-vexed subject of rationalized load factors. The desirability of getting back to fundamentals in load factor specifications and of establishing some degree of consistency among the requirements for the various parts of an airplane was a major item of interest in the discussion between the Department of Commerce and the representatives of the industry in Washington in July [see AVIATION for September, page 537], but no attempt to go into detail was made at that time. Professor Newell came forward at Cleveland with suggestions for definite formulas, for putting the load factors in terms of those elements of airplane design which he considered actually to control the magnitude of the largest loads falling on the structure.

He first reminded his audience that it is quite impossible to build an airplane to stand the largest loads that can be imposed by the most violent imaginable use of the controls, unless at the same time the machine be made unsatisfactory in maneuverability. There is plenty of evidence to show that a small plane can be pulled up from a dive to the angle of maximum lift with such rapidity that the load factor will be only about ten per cent below the theoretical maximum figure. For typical pursuit planes pulled up abruptly from a vertical dive that would correspond to a load on the wings of about 25 times the weight of the machine. On the other hand, an absolute maximum is imposed by the physical limitations of the pilot. So far as there is evidence on the point it appears that the human body cannot stand a load factor much, if any, in excess of ten without danger of serious injury. Allowing a true factor of safety of one and a half, pursuit planes need not then be designed for a load factory of more than about sixteen in any event.

It is clear, the author pointed out, that wing loads tend to increase with increasing maximum speed of flight and also with decreasing wing loading, whether the loads be due to maneuvering or those due to flying through bumpy air.

When it is maneuverability that is under consideration the power of the control is of course a factor, determining whether or not the pilot is able or likely to pull out of a dive very suddenly. As a measure of control Professor Newell accepts the familiar control constant, or ratio of the horizontal tail surface area to the wing area multiplied by the ratio of the distance between the center of gravity of the airplane and the tail surfaces to the wing chord, or

$$K = \frac{S_t}{S_w} \times \frac{l_t}{C}$$

Professor Newell then recommended a value of 3.5 KR^2 for the load factor in commercial planes, or 4.5 KR^2 in military types, K being the control constant and R the speed range ratio, and showed that in most cases the formula would give load factors within ten per cent of those now required by the Department of Commerce rule. Of course that in itself, while an interesting fact, is not a conclusive argument in favor of any formula, for the search for a new method of specifying load factors is naturally based on the assumption that the present method is not as good as it might be and is not in all cases correct. If a new method and the present one agreed throughout in their results there would be no reason for making a change at all.

The author next turned to the much more troublesome question of rear spar loads, as determined by the so-called "low angle load factors." He demonstrated that if the machine be pulled up abruptly from a dive at terminal speed, the load on the rear spars as well as that on the front ones increases steadily with increasing angle of attack until the angle of minimum lift is reached. The specifying of rear spar loading in terms of a particular low angle of attack can be justified only on the assumption that in flattening out from a dive the first 4 or 5 deg. of change of angle of attack will be accomplished without appreciable loss of speed, while thereafter the flattening out will be so gradual that the speed will fall off rapidly enough to prevent further increase in rear spar loading. The assumption seems reasonable, although as yet there are few experimental data to support it or to contradict it.

The paper included no direct formula

for specifying the low-angle load factor, but it contained a suggestion that an instantaneous pull-up from the diving attitude to the angle of attack at which the lift coefficient has one-quarter of its maximum value should be assumed in all cases. This would give the formula

$$\text{Load factor} = \tfrac{1}{4}\left(\frac{V_d}{V_{min.}}\right)^2$$

where V_d is highest speed of dive that would ever have to be reckoned with. In the case of pursuit machines, with which long vertical dives are made, the terminal speed may rise to six times the minimum speed, giving a low-angle load factor of nine. Professor Newell suggested that for commercial types the maximum reasonable diving speed should be determined and posted on the instrument board, with the warning that it must never be exceeded, the low-angle factor then being calculated on that basis. There are of course some commercial objections to such a practice, for experience shows that any mention of a machine's structural limitations, or any suggestion of the desirability of any measure of discretion in its use, immediately arouses in the pilot's mind a suspicion that the machine must be structurally weak in order to require such warnings.

Tail loads

The paper contained no comment on load specifications for fuselage, landing gear, rudder, or aileron, but stabilizer and elevator did come in for attention. There are two recognized formulas for determining the tail load when pulling up from a dive. That of R. V. Rhode of the N.A.C.A. reads:

$$\text{Load} = \left[.00544\left(\frac{S_e}{S_t}\right)^{1.39}\right] S_t V_i^2$$

while another developed by Lieutenants Fahrney and Gilbert, while studying under the supervision of Professor Newell, runs:

$$\text{Load} = F_1 + .00202\ S_e V_i^2$$

where S_e is the area of the elevator and S_t that of the entire horizontal tail surface C the wing chord, l_t the distance from the center of gravity to the center of pressure of the tail surfaces. V_i the diving speed from which the sudden pull-up is made, and F_1 the down-load on the tail for equilibrium in a steady dive at speed V_d. The Fahrney and Gilbert formula is based on the load carried by the tail in a straight dive, with the pull-up load imposed on the elevators superposed on it, the elevators being considered as a flat plate with an angle of 25 degrees for determining the additional increment of load.

In practically all cases these two formulas show good agreement, and for typical pursuit machines they give a total tail load about equal to the tail load in a terminal dive at limiting velocity without allowance for pull-up, the condition which British designers are required to meet.

Inverted flight conditions were expressly eliminated from consideration in the paper for lack of experimental data. Professor Newell urged the desirability of more study on the effect of suddenly pushing the stick forward and on loads in outside loops and similar maneuvers. He thought it very likely that two inverted conditions would ultimately be required, corresponding to the low-angle and high-angle conditions for normal flight.

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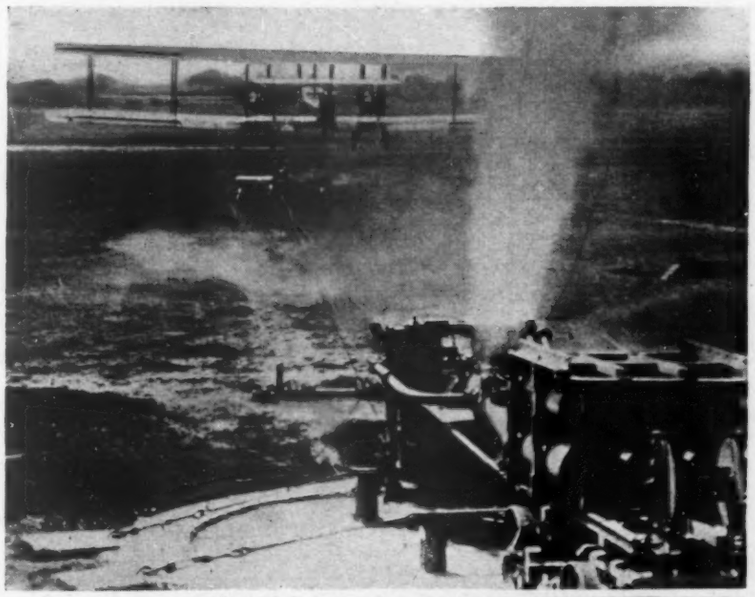
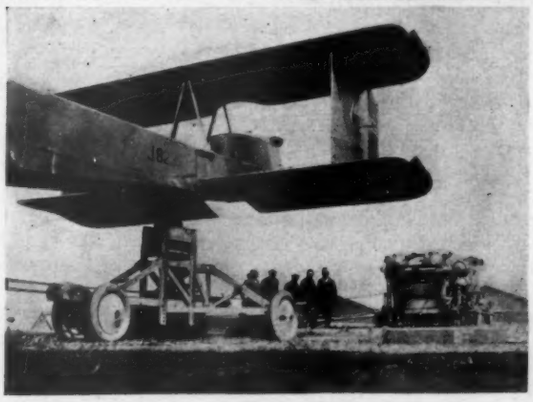
Catapulting on a large scale



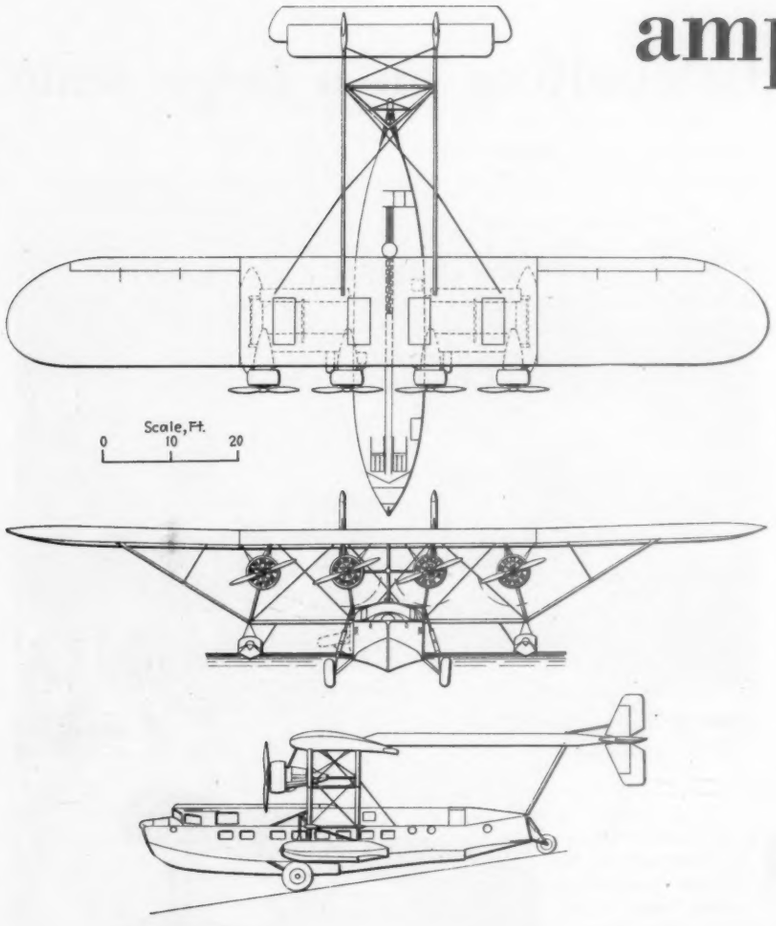


Catapulting a 7-ton bomber into the air with a 100-ft. run. Below: The plane is kept in flying position by means of this carriage placed under the tail wheel. Note the drum and compressed air equipment at right.

THE practice of catapulting airplanes of moderate size from the decks of ships has now become commonplace. Recently the Royal Air Force conducted an experiment in which a 7-ton Vickers Virginia bomber was successfully catapulted from the ground. The catapult operates by a cable wound around a drum which runs forward under the airplane to a pulley anchored well out on the runway and returned and attached to the nose of the plane by a special hook. Motive power for the drum is provided by two compressed air engines, which together develop 4,000 hp. Air for driving the motors is stored in compressed air cylinders at 400 lb. per sq.in. pressure. When ready to operate the engines on the airplane are run up to flying speed and the compressed air turned into the catapult. In the tests the plane attained a speed of 60 m.p.h. in 100 ft. in three seconds, at which point it took off in normal flight. As shown in the photograph, during catapulting the tail is supported in flying position on a special carriage.

The Sikorsky S-40 amphibion

A new giant for the Pan-American air fleet

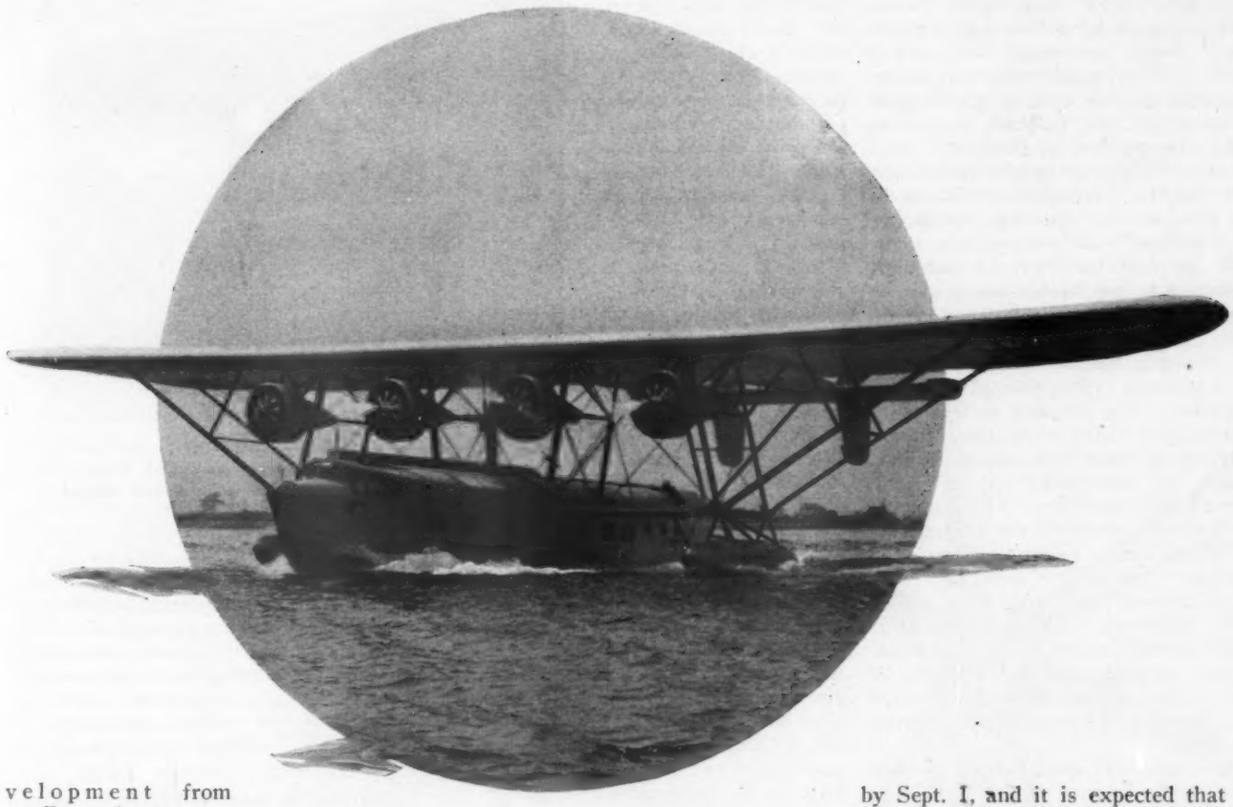


FOLLOWING almost immediately on the close of the World War, certain European nations, foreseeing the possibilities which aerial transport offered in binding more closely together the far-flung units of their colonial empires, encouraged the establishment of experimental airlines between certain strategic points, lending their assistance to private enterprise in the form of substantial subsidies. To-day England, France, Germany, and Holland have either surveyed, or put into actual operation, direct air connections to practically all of their outlying possessions. During the early 1920s progress in the United States lagged behind that abroad due largely to the unwillingness of the governmental to support operations by granting direct subsidies. Since 1927, however, development has been rapid, and in 1931 the American controlled airways, both in the United States and in Central and South America, are second to none.

By processes of merger and consolidation a number of independent airway systems are now in existence in various parts of the world, each having been shaped to meet the several needs of the nation controlling it. Here and there, where geographical conditions permit, these lines make contact, permitting passengers and goods to be transfered from one system to another, but, more often than not, they are widely separated by natural barriers of ocean or mountain range over which regular flying operations have hitherto been considered impractical. It is only natural, therefore, that the various networks, having worked out their individual problems, should turn to the greater one of interconnection, and the establishment of world-wide trade routes of the air.

One of the most important, and at the same time, one of the most difficult interconnecting routes is that between Europe and North America. With a view toward the establishment of mail and passenger schedules over the Atlantic, Pan-American Airways has been making an exhaustive study of means of connecting with the Imperial Airways via Bermuda and the Azores. They have, during the last four years, acquired considerable experience and equipment for the relatively long over-water jumps between the United States, and Central and South America. Their equipment has been limited, however, to airplanes of a gross weight of 7 or 8 tons, and a cruising range of about 500 miles, but nothing has been available to compare with the long-range flying boats developed by England for the India-Australia, or the South African routes. Although present schedules do not yet afford sufficient passenger volume to justify the purchase of airplanes of a comparable size, yet it was considered that a requirement for long over-water flights with heavy loads was sufficiently imminent to warrant the authorization of two experimental amphibion flying boats of a size far beyond any which had hitherto been designed and built in the United States.

Since there has been no gradual de-



velopment from smaller units to ones of the size contemplated it was necessary to hurdle in one jump the gap between the design of an amphibion of 8 tons gross weight, and one of 17 tons. An order was placed with the Sikorsky Aircraft Corporation, however, for the first two machines of this displacement, the first of which has been successfully test flown, and is now ready for delivery. Neither of the boats is intended for trans-atlantic service, but they will be commissioned on the 1300-mile overwater route between North and South America where their performance will be closely studied with a view toward the development of equipment for the longer trans-oceanic flights. Both purchasers and designers showed some boldness in attacking the problem of the financing and building of airplanes on such a scale at the present time.

General specifications

The Sikorsky S-40 is a high-wing monoplane amphibion of the same general type as the well known S-41, which is characterized by the carrying of the tail surfaces on a pair of outriggers. Four Pratt and Whitney direct-drive Hornet engines of 575 hp. each mounted as tractors in nacelles hung below and forward of the leading edge of the wing furnish the power. A single vee-bottom hull containing all accommodations for passengers and crew is supported below the wing, and a pair of outboard wing floats lend stability on the water. Fully retracting landing wheels and tail wheel have been provided, but the machine may be flown as a flying boat with considerable improvement in performance, and with some 1800 lb. of additional payload available. The general arrangement of the machine and its overall dimensions are shown in the three-view drawing. Rigged as an amphibion, the expected net weight empty is 21,500 lb. which, with a designed gross loading of 34,000 lb., allows some 12,500 lb. for useful load. On the basis of the gross weight, the wing loading is then 18.2 lb. per sq.ft. and the power loading 14.8 lb. per hp. With accommodations for 24 passengers the S-40 is expected to have a range of approximately 950 miles, and with the maximum load of 40 passengers, a useful range of about 500 miles. On test flights with full load the machine has attained a high speed of better than 130 m.p.h., cruises at 110 to 115 m.p.h., and lands at approximately 65 m.p.h. A rate of climb of 712 ft. per min. was obtained, and an absolute ceiling of 13,500 ft. is predicted. A ceiling of 6,500 ft. has been reached with full load on three engines, and level flight at 2,000 ft. has been maintained on two engines with a gross loading of 29,000 lb. With 34,000 lb. gross the plane attained an altitude of 5,250 ft. in 10 min. Engineering tests on the S-40 rigged as an amphibion and carrying full load were satisfactorily completed by Sept. 1, and it is expected that the first machine will be ready for delivery to the Pan-American Airways some time before Oct. 1.

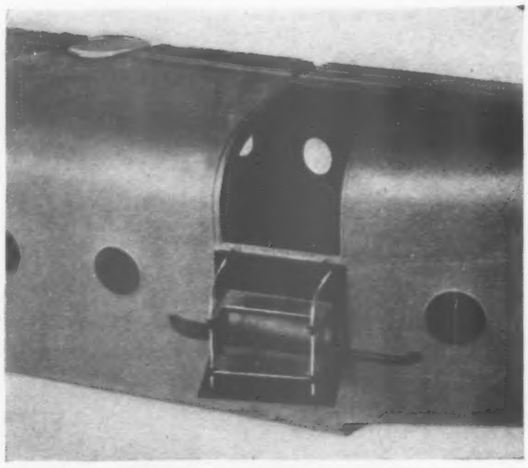
Hull and wing floats

In the preliminary work of hull design for the S-40 (which dates back to April, 1929) twelve models of varying shapes were exhaustively tested for aerodynamic and water-running characteristics. Part of this work was carried out in the Washington Navy Yard towing basin, but the greater part was done in the Housatonic River by towing models alongside a motor boat (Page 288, AVIATION, May, 1931). In the accepted design the vee bottom has two steps, one located approximately at the mid-point of the 58-ft. hull, and the after step about 10 ft. from the stern post. The portion of the bottom just ahead of the after step has been given a decided throw-down, and the keel line aft of the rear step slopes sharply upward to give adequate water clearance when the machine is running on the step. The side plating is vertical, and perfectly flat from chines to gunwales. The decking over the cabins is well rounded from gunwale to gunwale, and is practically level along the top longitudinal chord for the greater part of its length. It is rounded down over the cockpits, and tapers down to the stern post in a turtle-deck aft of the rear step bulkhead. A short section forward of the cockpit is carried well below the main deck level to permit adequate pilot vision forward. The gross submerged

displacement of the hull is 109 tons.

The construction is all-metal, incorporating extruded duralumin shapes and Alclad sheets, assembled with dural rivets. The principal structural member of the hull is a deep girder type keel to which the built-up transverse frames are attached at relatively short intervals. Light stringers spaced on short centers interconnect the transverse frames. Six plate-type bulkheads, each equipped with a watertight door, divide the hull into seven water-tight compartments, any two of which may be completely flooded and the plane remain afloat. At the point where the rear wing trussing transfers its load to the hull a skeleton type bulkhead has been substituted. The framing at this point is made up of heavy round dural tubing assembled by means of special fittings. It will be surrounded by a light, non-watertight partition. The construction is shown in one of the accompanying illustrations. Gunwales are deep duralumin channels mounted with flanges upward, and with webs drilled out for lightness. The hull plating is rivetted directly to the transverse framing, and is reinforced longitudinally by angle stringers. All seams were sealed with fabric and marine glue during assembly.

Three generous sized hatchways give access to the interior of the hull. The after hatch is designed to be the main entrance, and is located so that passengers may embark either from a tender, or from the ground. The cover swings outward and downward to form a short series of steps for the convenience of the passengers. The other two hatchways are for emergency use, or for the loading of unusually bulky cargo. Four circular ports, and eight rectangular windows are provided in each side. The latter are large enough for emergency exit purposes. They are closed with non-shatterable plate glass in frames so arranged that they can be swung outward from the bottom to afford ventilation. Extra reinforcement has been included around the window openings in the hull plating to reduce the possibility of windows being wedged shut in the event of a crash.

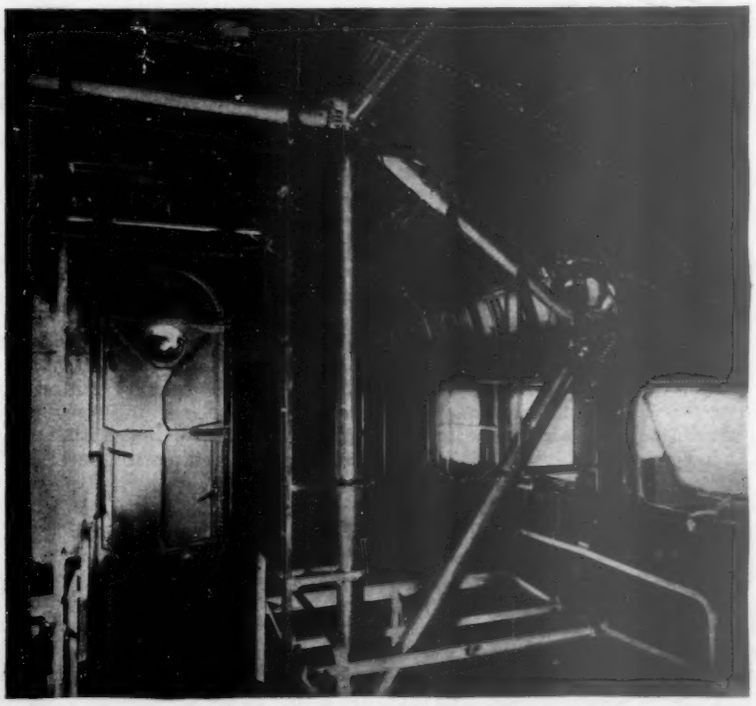


The after hatch with cover open. Note also the details of the hull plating, and the mounting ring fitted in the deck for the carriage of a spare engine.

Incorporated in the hull structure are several interesting and novel features. A rectangular conduit housing the engine control cables and pulleys is located over the cockpit and cabins outside the hull proper. This arrangement permits easy access to the controls without disturbing the hull structure or cabin linings. A short distance aft of the end of the conduit, and just forward of the after hatchway, an engine mounting ring is built into the cabin roof structure. Normally a circular cover preserves the continuity of the deck line, but in cases where a spare engine is required at some outlying repair station, the cover may be removed, and the engine bolted down to the mounting ring in the deck. This construction affords a very convenient way of transporting such spare equipment in emergencies without sacrificing cabin room, or without the need for complicated handling arrangements to lower an engine into the hull.

Retractable landing lights are set in the side plating of the hull ahead of the cockpit, and a small hatch in the forward decking gives access to the anchor which can be drawn up into the hawse pipe conveniently by one man using a small winch. A bumper of the usual Sikorsky type is fitted at the bow.

The wing floats are of the same general construction as the main hull, being made up of duralumin framing members covered with Alclad sheet. They are also of the vee-bottom type, with a single step. The most interesting feature is the incorporation of a 246-gal. gasoline tank in each. The tanks have the same width and cross-section as the deck of the float, and the central portion of the decks between the points of attachment of the supporting strut fittings is recessed to form a sort of saddle into which the tanks fit to complete the deck lines both laterally, and fore and aft. Since the tanks are not integral with the floats there is little likelihood of loss or contamination of gasoline due to damage when taking off or landing. The floats are carried on streamlined horizontal struts which extend outward from the hull, and form a portion of the wing truss system. A typical outboard fitting is shown in an accompanying sketch. The submerged displacement of each float is 7,250 lb., and their effective righting factor is 4.2 with full load.



Cabin interior during construction showing the skeleton bulkhead amidships.

Wings and tail surfaces

The monoplane wing of the S-40 is made up of a center-section with a span of 44 ft. fastened directly to the hull,

carrying the tail outriggers and the four engine nacelles, and two tip sections, each 34 ft. 11 in. long, making the overall wing span 114 ft. The framing is built up of extruded duralumin sections, and formed dural sheet with a certain amount of steel plates at various fittings. The entire structure is fabric-covered with the exception of a metal skinned portion of the center section over the engine nacelles.

The wings are of the conventional two-spar type. The front and rear beams are of a deep girder truss construction made up of extruded channel flanges and formed sheet channels, connected by gusset plates. Drag struts of similar construction connect the two beams at frequent intervals. The ribs are built up of extruded tee and channel sections, the former being used for cap strips, and the latter for web bracing. Inset ailerons of the balanced type are mounted in the tip section. A false spar carrying the aileron hinges is supported by cantilevered brackets extending outward from the rear spar at each drag strut. All aileron hinges, as well as all other hinges and control pulleys on board, are ball bearing.

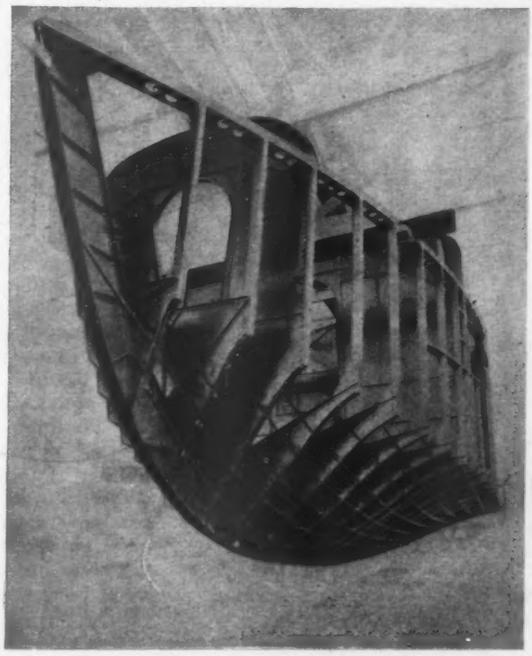
The aileron control is of the cable and pulley type, the cable from each aileron running in toward the center section just behind the rear spar. Within the center section the cables are attached to a pair of yokes which in turn are connected by links to a large sheave as shown in the accompanying sketch. Control wires from the cockpit come up through the roof of the hull. Rotational movement of the sheave produces a rocking motion of the yokes, which is transmitted by the cables to the ailerons.

Tail surfaces are of the familiar Sikorsky type, including fins and rudders of special airfoil section to correct for unbalanced slip-stream effects due to stoppage of one or more engines, and are of the same general construction as the wing, being fabric-covered over dural framing. Counterbalancing is employed on both elevators and rudders, and stabilizer adjustment is obtained by rotating the entire tail assembly, including the fin and rudder, about point of attachment to the outriggers.

The latter differ materially in construction from the usual Sikorsky fabric-covered lattice type. They consist of duralumin box girders built up with plate webs and zee bar flanges. Numerous longitudinal and transverse angles are rivetted to the inside surfaces of the web sheet to secure stiffness. In order to make this type of construction feasible, each boom was made up in symmetrical halves and assembled by placing them together and rivetting up the outside legs of the top and bottom flange zee bars.

The power plant

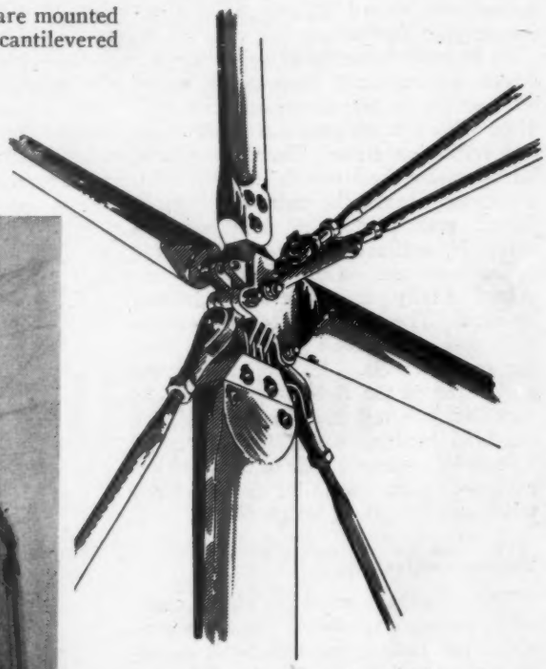
The four Hornet engines are mounted in dural framed nacelles cantilevered out from the wing trussing system below and ahead of the leading edge.



Bow view before plating showing hull lines, and construction of the keel, transverse framing, and bulkheads. Right: A typical fitting. Outer lift strut and wing float brace joint with fairing removed

Each nacelle is well streamlined and its engine surrounded by a Sikorsky type ring cowl. Two-bladed Hamilton Standard propellers, 10 ft. 6 in. in diameter are driven directly by each engine.

The fuel supply of approximately 1,080 gal. is carried in six tanks, four of which, of 147 gal. each, are located within the wing immediately above each engine nacelle, and two others, each of 246-gal. capacity, are located in the wing floats as described previously. Fuel lines are so arranged that any engine or group of engines may be fed from any one or any group of tanks. All valves and pumps are located outside the hull and are operated by remote control. It is thus impossible for gasoline fumes to enter the cabins and cause discomfort to the passengers. This feature makes possible also the permitting of smoking in the cabins without danger of fire. Electrically driven pumps, located at the float tanks, raise the fuel to the wing tanks as required. A hand pump is provided for use in case of failure of the electric pumps. The float tanks are provided with self-closing dump valves, so that their fuel load may be jettisoned wholly, or in part, in case of



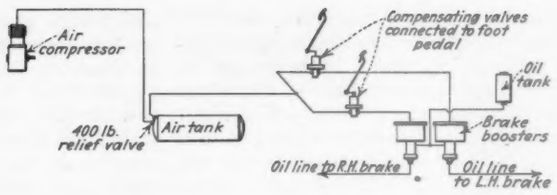
emergency. Individual lubricating oil tanks are mounted in each nacelle.

All engine controls pass from the pilot's cockpit through the conduit in the roof of the hull from which they lead upward to the center section of the wing through a streamline housing. From the center section the controls are distributed to the various engines by double cables carried along the front face of the forward wing spar. Over each point of attachment of the engines the controls are diverted downward into the nacelle by means of an ingenious arrangement of yokes and sheave segments bracketed to the front spar. It is interesting to note the use of heat-treated dural castings for various parts of the control system. All such castings and all forgings or fittings carrying loads of any sort in all parts of the plane were subjected to X-ray examination before being installed.

Amphibion gear

The amphibion gear supplied with the first S-40 is of the usual Sikorsky type, and is notable largely on account of its

relatively great size. The two main wheels are of wire spoke construction and carry hydraulically-operated brakes similar in design to those used on the S-38. Due to the high pressures required to operate brakes of this size, a servo system has been introduced whereby the hydraulic brake system is actuated by compressed air which, in turn, is controlled by valves at the brake pedals. The elements of the braking system are shown in one of the accompanying figures.



Schematic diagram of brake system.

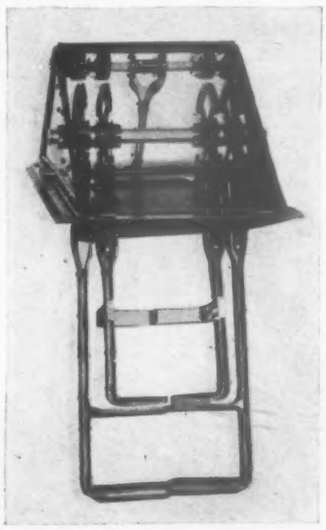
As in other Sikorsky models, the main wheels are retracted clear of the water but remain in the airstream. Each is fitted with a combination Sikorsky oleo and retraction strut. The oil required for operating the struts is supplied from a storage tank through an engine-driven gear pump. A hand-operated pump is available in the cockpit for emergency use. One minute is required to fully retract the undercarriage by hand. The tail wheel is also retractable, and operates in conjunction with the main wheels. A reminder of the great size of the S-40 is given by the fact that the tail-wheel employed is a standard landing wheel for the S-38. The main landing wheels of the S-40 are equipped with 58x14-in. tires. Each wheel and tire alone weigh 600 lb.

Accommodations

The arrangement of the pilot's cockpit is quite conventional. Space is provided for radio equipment and an operator, as well as a mechanic. The two pilots sit side by side with complete dual controls. A full set of navigational instruments is available for both. A passageway between the two seats gives access to the anchor compartment. A throttle control of unique and ingenious design which is shown in one of the accompanying photographs is suspended from the cockpit roof between the two pilots. With this arrangement either may, with one hand, control all the engines singly or together, or in any combination which he may choose. The two lower handles are connected to the outboard engine, the two upper ones to the inboard engine, and by grasping the two sets of split handles in the center, all four may be throttled simultaneously. An adjustment, not shown in the picture, makes it possible to synchronize the throttle setting of all engines while the plane is in flight.

One of the most important problems from the standpoint of passenger comfort is reduction of noise, for which purpose the entire cabin is being lined with a thick blanket of insulating material between the outer shell and the inner panelling. Observers on board the plane during its trial flights reported that, even without any insulation in the cabin wall, the internal noise was greatly below the level of that in the average transport airplane and that very little vibration was experienced. Because it is believed that a certain amount of vibration enters a hull from outboard propellers, special reinforcement has been provided in the skin of the hull in the section which lies in and adjacent to the plane of rotation of the propellers. Other factors which are planned to lessen objectionable vibrations in the cabin are the relatively remote location of the power plants, and the vibration-absorbing capacity of the relatively large mass of the structure. A well-equipped galley, including electric range and a refrigerator, has been installed, and separate lavatories for men and women are provided. It is not the intention to operate the plane crowded to absolute capacity in passengers, but rather to limit the accommodations to the point where each passenger has adequate room to sit or move about in the greatest possible comfort.

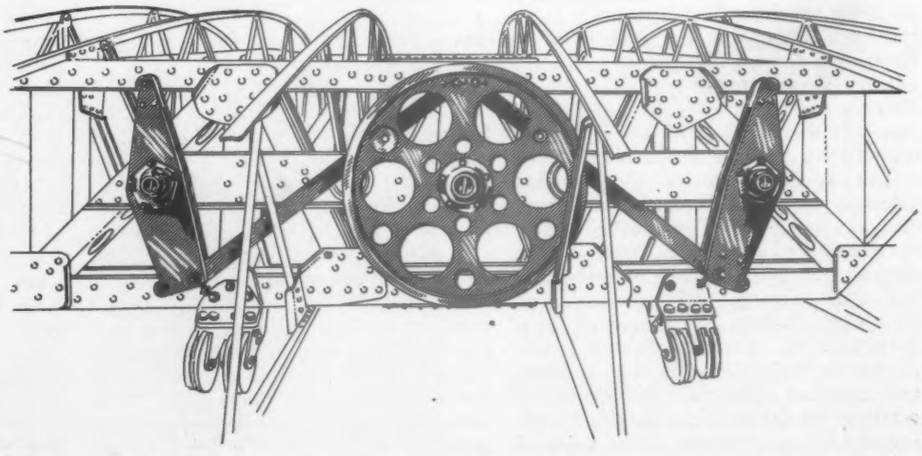
Particular attention has been given to the selection and arrangement of the furnishing and fittings of the cabins. Every scrap of material which has been used inside the hull has been made fireproof by chemical impregnation.



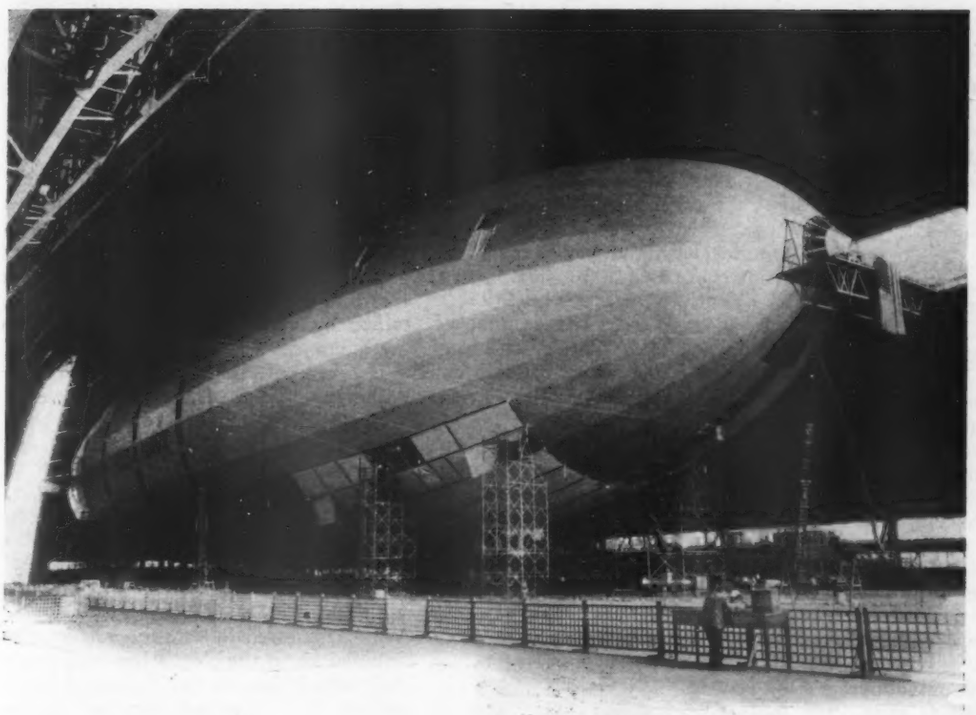
The throttle control in the cockpit.

Decoration

The problem of interior decoration was placed in the hands of Mrs. Guy Murchie, who has made the furnishing of aircraft her hobby. She has made a study of suitable colors and fabrics, and has made a large number of experimental arrangements to determine the most appropriate combinations for the S-40. She was allowed a maximum of 1,000 lb. to include wall coverings, carpets, seats, cushions, lighting and window fixtures, and galley equipment. By a combination of light, natural finished wood panelling, dull finished silver fixtures, blue carpets, and orange seat covers an effect of cool spaciousness has been achieved which suggests comfort and convenience without intrusion of mechanical aspects of flight.



Differential control for aileron on rear spar at the center section. Cables from cockpit are fitted around sheave, and double aileron cables attach to yoke arms.



The largest dirigible

A brief but comprehensive description of the U.S.S. Akron's design and construction

	Los Angeles	Graf Zeppelin	Akron
Nominal gas volume (cu.ft.)	2,470,000	3,700,000	6,500,000
Length overall (ft.)	658.3	776	785
Maximum diameter (ft.)	90.7	100	132.9
Height overall (ft.)	104.4	113	146.5
Gross lift (lb.)	153,000	258,000	403,000
Useful lift (lb.)	60,000	.....	182,000
Number of engines	5	5	8
Total horsepower	2,000	2,750	4,480
Maximum speed (knots.)	63	80	72
Range (miles)*	3,800	5,300	9,200

* At 50 knots cruising speed. without refueling.

LESS than one year after the greatest catastrophe in lighter-than-air history—the lamentable failure of the English R.101—appears a new prophet in the shape of the ZRS-4, better known as the U.S.S. Akron. This airship not only is the latest exponent of the type, but because it is larger than any yet launched, represents pioneering in many aspects of construction and operation. It is the product of the Goodyear-Zeppelin Corporation and is heir to Zeppelin experience through close co-operation between that company and the German plant. The general theory of the design is conventional. That is, there is a cloth-covered hull made up of transverse frames and longitudinals supported by a series of balloonets. In structure and in detail arrangement, however, there are notable innovations.

The best known of the novelties is the placing of the engines within the hull, rather than in gondolas on outriggers where they offer serious resistance and provide limited working room for mechanics. This is the first actual adaption of an old Zeppelin idea. There are eight 8x8-ft. engine compartments within the envelope, each equipped with the usual instruments, and a specially built blower to provide fresh air for the engine intake, and for ventilation of the crankcase and the room. There is also a wheel by which the angle of the propeller shaft may be controlled.

This novel engine arrangement involves the use of a 16-ft. propeller shaft to outriggers where bevel gears transmit the thrust to a short shaft attached directly to the propeller. Still another innovation has been introduced here by making the gear housing tiltable through an arc of 90 deg. downward from the horizontal. This permits obtaining from the engines a total upward thrust of about 6,000 lb. or a downward thrust of about 10,000 lb. The engines are reversible.

The transmission system gives a speed reduction of 7 to 4 so that a crankshaft speed of 1,600 r.p.m. becomes a propeller speed of 925 r.p.m. The two-bladed wooden propellers are especially designed to be effective in the disturbed air resulting from location of the propellers on each side in the same horizontal line and only 74 ft. apart.

The engines themselves are an improvement over previous Maybach models. They are Maybach VL-2,

giving 560 hp. at sea level. They have twelve cylinders each, 60-deg. vee-shape, a compression ratio of 7-1, aluminum pistons and crankcase, main and connecting rod bearings of roller type, and compressed air starter. An engine weighs dry 4.5 lb. per hp. and consumes 45 lb. of fuel per hp. of power.

Frames inherently stiff

A notable departure from previous practice is the use of inherently stiff main frames, which do not need any internal wire bracing. The closest previous approach to this stiff frame was in the R.101. The R.100 and all German-built Zeppelins were heavily wired. The intermediate frames are rings of ordinary airship girders, some 10 in. deep, attached end to end. Broadly speaking, the main frames are composed of three such rings, one of smaller diameter than the other two and joined to them by trusses. The resultant triangular section is about 6 ft. deep and is stiff in all directions without wires to brace it.

Girders built up of aluminum alloy sheet channel sections, their webs lightened and stiffened with flanged holes, serve as chord members of most frames. Where compression or tension loads predominate these channels are joined with side plates, also perforated with punched and flanged holes, forming a box section. For bending stresses chords are spaced by short channels of same width to give a truss effect. The R.100 girders are made up of duralumin tubular booms connected with duralumin bracing while those in the R.101 were built up of steel booms with duralumin bracing.

Still another new feature is the resilient bulkhead, the "fence" in the plane of each main frame to restrain the gas cells in each bay from overflowing their proper space in case of deflation of an adjacent cell. This bulkhead was necessitated by the absence of the main frame wire bracing which in the usual airship serves also as the fence. Such wires, however, have the serious disadvantage of being rigid, and pressure of a gas cell upon them imposes great stresses in the frame. Since the Akron's bulkheads are for restraining the gas cells only, the wires are fitted with springs on one end and an oleo shock absorber on the other to limit the forces that may be transmitted to the frames.

Three keels for strength

Another novelty is that the ship has three keels instead of the usual one. Two run along the lower sides of the hull about 45 deg. from the center line, the third along the top. Engine rooms, quarters and fuel tanks lead off the lower corridors; the gas cell valves and control cables are in the upper one.

This is the first large airship ever to be built without the use of goldbeaters skins in the gas cells. Only recently has research provided substitutes with approximately equal retaining ability and at lower cost. Six of the Akron's twelve helium cells are made of 2-oz. cotton cloth coated with several layers of rubber latex and an outside coat of paraffin; the other six are of the same cloth coated with several layers of a mixture of gelatin and rubber latex and an outside coat of paraffin. The largest cell is 130 ft. in diameter and 74 ft. thick. The cells required a total of 56,000 yd. of cloth. The outer cover is made up of 36,000 sq.yd. of cloth cut in panels 74 ft. by 12 or 24 ft. wide, and laced through eyelets to the hull.

Taking a lesson from the Shenandoah disaster, the designers have incorporated two or four valves in each cell, so the ship may rise as rapidly as 4,000 ft. per min. without serious increase in internal pressure. These valves are 32 in. in diameter and are either fully automatic or both automatic and manual. All are located along the upper corridor formed by the top keel.

Acme

The nose, showing some construction detail

Harnessing the lift

The total lift provided by all cells is 403,000 lb. on the basis of a nominal helium volume and a lifting power of 0.062 lb. per cu.ft. Lift is transmitted from the cells to the ship through a wire netting which criss-crosses the thick outer edge of each cell and is secured to the inner rings of the main frames. On the R.100 this is accomplished chiefly by means of a wire mesh installed in panels between the longitudinals.

The Akron is the first airship to provide for operation of airplanes as a regular function and the first to make any provision for housing a complement of airplanes. The hangar, or well, is 70 ft. long, 58 ft. wide, and 16 ft. high, with a hatch—T-shaped like an airplane—32 ft. wide and about 40 ft. long. The hatch is fitted with a set of doors sliding back on tracks into the interior of the ship. Trapeze and trolley devices for the handling of the planes will not be installed until several months after the ship has been commissioned. To provide the hatch it was necessary to cut away parts of several longitudinals; continuity of strength has been maintained by carrying the framing above the hangar.

Because of fin trouble on trans-Atlantic voyages of the Graf Zeppelin and the R.100, the Akron's fins have been much strengthened. They are larger in proportion to the hull than usual practice. The counterbalances on the fin surfaces are new, having aileron characteristics to assist their own performance. Water condensers are located in vertical groups of fifteen flush with the skin to reduce air resistance. Water is stored in 44 rubber bags distributed about the ship. Directly above the control car are the radio and aerological room, quarters for the captain and a few of the officers, office space and a photo laboratory. Other living quarters are abreast the airplane hangar, approximately amidships. Miscellaneous apparatus, such as the electrical equipment, are all designed along the compact lines of installations on small naval vessels.

Assembly by patterns

Designing and fabrication of the construction units were done at the Goodyear-Zeppelin shop adjoining the Goodyear rubber plant in Akron. The frames were assembled on the dock floor in conformity with patterns painted thereon, and built up with jigs. As each frame was completed, it was raised into the vertical position and the longitudinals and wires attached.

The construction routine naturally included many tests of various parts, joints, and accessories. Among them was an investigation of the torsional characteristics of the drive gear interposed between the engine and the propeller which included about 450 hours running of the gear.

Few major modifications have been made to the original design, although many minor refinements were carried out. The more important changes included relocation of the control car, modification of the fin arrangement to better facilitate operating and handling arrangements, change in the electrical system, rearrangement of living quarters and equipment, and modification of ground handling arrangements. Despite the minor and the major changes, the finished structure was only 3 or 4 per cent over the weight originally estimated.

A survey of the facilities of 256 airports

What service for the tourist?

IN these days when the ubiquitous automobile servicing station spreads like a rash across the face of the country, the man who is contemplating a tour by air wonders what similar facilities are available to him in the event he has mechanical difficulty with his machine. In order to obtain some idea of the present situation in that regard, AVIATION recently inquired of a number of representative airports in this country as to the kind and quality of the servicing which they had available, and 256 fields distributed widely throughout the United States furnished data.

In order to indicate the scope of the service available, airports were asked to indicate the extent of their facilities, including whether or not they were equipped to handle airplane structural repairs, engine repairs, or both. They were requested to indicate also the character of their repair shops, and whether or not they offered full 24-hour service. It was thought also that the size and type of the stock carried was an indication of their ability to conduct general servicing operations, and they were asked to report on the approximate size and turnover of their stockroom inventory and to give an indication of its general make-up.

Of the 256 replies received, 227 made statements with reference to the scope of service offered. Of this number, 114, or 50 per cent, indicated complete airplane and engine maintenance; 28 per cent reported minor repair facilities only (in several cases indicating only the accessibility of an adjacent garage or the services of an automobile mechanic), and 13 per cent reported that no repair services of any kind were available. The number of shops which specialized in either airplane or engine repair (one to the exclusion of the other) was almost negligible. Our wandering pilot would, therefore, be able to get some sort of mechanical assistance at almost any airport at which he might call, and in at least half of them he could obtain a complete overhaul of either his airplane or engine at the hands of a relatively skillful crew. In addition, if he were interested in flying at night, he would find that well over half of them offered 24-hour servicing.

Table I

Inventory in dollars	Number	Per cent
No stock carried..	25	19
Up to 1,000.....	38	29
1,000- 5,000..)....	30	22
5,000-10,000.....	12	9
10,000-20,000.....	9	7
20,000-50,000.....	12	9
50,000-100,000....	2	2
Over 100,000.....	4	3
Total.....	132	100

An interesting aspect of the ability of the various airports to serve came from a study of the reports on inventory and turnover. Although there was apparently more reluctance to give out information on these subjects, as indicated by the fact that only 132 airports gave estimates on their inventory, and only 56 had anything to say about turnover, yet the data received are numerous enough and sufficiently well scattered geographically to be of some significance. An arbitrary classification of inventory figures was set up, and the study yielded the distribution shown in Table I for those reporting.

This table is an indication that the average airport carries on hand a reasonable amount of spare parts and supplies for the servicing of aircraft. Less than 20 per cent have no such stock available and approximately 60 per cent have an inventory varying upward to $10,000 in value. The small minority which reported stock valuations in excess of $100,000 included only airports run in connection with aircraft supply houses, manufacturers or transport operators, and the number is so small that they are scarcely of direct interest to the average aerial tourist.

Table II

Monthly turnover in dollars	Number	Per cent
Up to 100.....	16	28
100-500.....	14	25
500-1,000.....	11	20
1,000-5,000.....	11	20
5,000-10,000.....	1	2
Over 10,000.....	3	5
Total.....	56	100

Although the reports on turnover were rather meager, they were at least indicative of the amount of business which airports are conducting. Again an arbitrary classification was made which is shown in Table II.

Looking at the rate of turnover, it was found that by far the greatest majority averaged from 100 to 170 per cent yearly, and only 20 per cent claimed a turnover of 200 to 300 per cent. In other fields of merchandising where comparatively large and expensive units are offered for sale, as is the case with furniture, hardware or electrical goods, the average turnover is from 200 to 300 per cent annually, and chain stores handling tobacco or foodstuffs may run as high as 4,000 to 5,000 per cent. High rates of turnover normally lead to reduced unit selling prices as a reasonable overall profit may be realized from the addition of a relatively small profit increment on each unit where volume of sales is large. Since the above turnover figures indicate that the present volume of sales of parts and supplies at the average airport is relatively small, it is obvious that the prices which must be charged must include a large profit differential, and therefore be higher than will be necessary as demand increases.

Regardless of the size of the airport, gasoline and oil are usually available. Only ten of the 207 fields which replied to this question state definitely that they did not handle fuels and lubricants. If the air tourist can locate anything that has any of the earmarks of an airport the chances are that he will be able to replenish his supplies of this sort, and, furthermore, he may point the nose of his airplane toward almost any part of the United States with the reasonable assurance that he can locate some sort of mechanical assistance at the majority of airports at which he may touch.

Flying Equipment

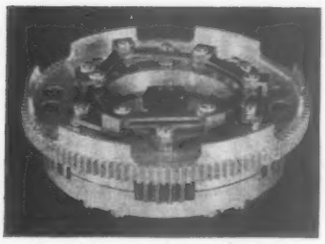
SERIES B-1 HORNET ENGINE

A NEW radial air-cooled airplane engine has recently been completed and tested by the Pratt & Whitney Aircraft Company, of East Hartford, Conn. Although based primarily on the Series B Hornet engine which was first announced in 1929, the new engine, the B-2, incorporates several modifications, notably a 3 : 2 propeller drive reduction, higher compression ratio, and improvements in the supercharger drive and oil temperature regulating system.

The new reduction gear consists primarily of a fixed gear splined to the crankshaft which drives six pinions enclosed in a cage floating on the crankshaft, and interconnected by equalizing links so that each bears its designed share of the load. The floating pinion cage equalizes the movement tendency of the crankshaft and provides for equal strain on the driving and the driven gears under all conditions of operation. The pinions drive a bell gear which is part of the propeller shaft. Both propeller shaft and pinion shaft are mounted on roller bearings and the entire reduction gear housing may be removed with the propeller shaft for inspection.

In the case of the 12:1 blower gearing, the most notable departure from standard practice is the use of a special cage bolted to the blower section supporting the front of both the intermediate and the impeller shafts. In the standard drive the intermediate shaft has no rear bearing and the impeller shaft is supported on a boss cast in the blower section, but the requirements for higher blower speed in the new engine necessitated an increase in bearing size. The floating gear of the drive incorporates two sets of teeth, one of which engages the clutch on the rear of the crankshaft and the other drives the intermediate blower gear. The floating gear is mounted on a roller bearing and is supported on the outside of the main cage, which in turn supports the impeller shaft and the intermediate drive shaft.

Special pistons, fitted in the B-1 Hornet give a compression ratio of 6 : 1 instead of the standard 5 : 1. With regard to oil temperature control, a combination hot-spot and oil regulator is used which provides means not only of heating the mixture in cold weather but also for cooling the oil by passing it through a radiator core placed in the intake system between the carburetor and the supercharger. A manually-operated bypass valve provides a positive means of controlling the oil temperature within any desired limit.

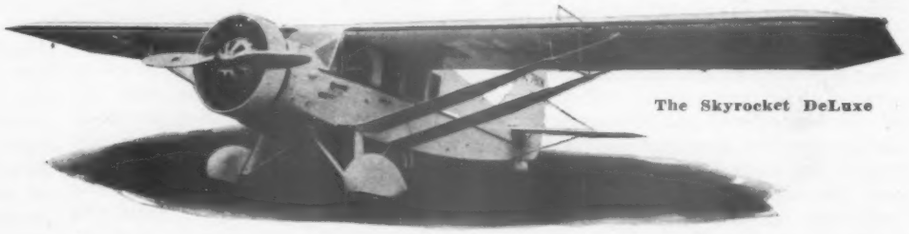


Pinion cage of 3:2 reduction gear on supercharged geared Hornet

According to the manufacturers, the new engine is rated at 575 hp. at 2,000 r.p.m. at 8,000 ft. altitude. The weight, including carburetor, running magnetos, combination hot-spot and oil regulator, air scoop, generator drive and propeller hub attachment parts is given as 915 lb. On this basis, the engine weighs 1.75 lb. per hp. at 8,000 ft. and 1.18 lb. per hp. at sea level.

GREAT LAKES SPORT TRAINERS

THE two 1931 models of the well-known Great Lakes Sport Trainer follow very closely the lines laid down for these machines in previous years. The chief improvement in external appearance is around the nose where careful attention to engine mounting and cowling has resulted in better lines. The new models are offered with optional power plants, either an upright four-cylinder Cirrus or the inverted four-cylinder Cirrus Ensign. The exhaust stacks provided with both models are finned for cooling. Both machines are open cockpit biplanes designed for tandem seating of two persons. The upper wings are rigged with considerable sweepback and no dihedral, whereas the lower wings are rigged without sweepback and with several degrees of dihedral, resulting in considerably more stagger at the center section than at the wing tip. The material and the type of construction



The Skyrocket DeLuxe

The Great Lakes Sport Trainer with Cirrus Ensign engine

are conventional throughout. The general characteristics of the two machines are similar and are given by the manufacturers as follows:

Length overall	20 ft. 4 in.
Height	8 ft. 5 in.
Span	26 ft. 8 in.
Wing area	187 sq.ft.
Gross weight	1,580 lb.
Weight empty	1,015 lb.

NICHOLSON JUNIOR

A NEW light monoplane has been designed and recently test flown by Mr. H. G. Nicholson, Jr., of Tonawanda, N. Y. The machine is a high wing, single-place, semi-cantilever monoplane powered with a 45-hp. Szekely engine. It is intended that later models will be fitted with seats for two persons, as perliminary test flights have indicated that an additional 170-lb. load may be carried safely in the single-seat experimental machine.

Material and construction are conventional. The fuselage is built up of welded chrome molybdenum steel tubing as are the landing gear and tail surfaces. Wings consist of laminated spruce spars, Hyblum ribs, fabric covered, and ailerons are built on spruce spars with duralumin ribs, also fabric covered. The undercarriage is fitted with semi-oleo shock absorbing struts and Goodyear Airwheels. The general characteristics of the new two-place model, as given by the designer are as follows:

Length overall	23 ft.
Length (wings folded)	24 ft.
Span	37 ft.
Width (wings folded)	12½ ft.
Wing area	190 sq.ft.
Gross weight	980 lb.
Weight empty	540 lb.
Wing loading	5.15 lb. per sq.ft.
Power loading	21.8 lb. per hp.

BELLANCA SKYROCKET DELUXE

A NEW model of the well-known Skyrocket has recently been announced by the Bellanca Aircraft Corporation, of New Castle, Del. The basic design is similar to that of the previous models first introduced in 1930, but increased speed has been obtained by the addition of extra features and refinement of detail.

The machine is powered with a Pratt & Whitney Wasp series SC engine with a 5¼ : 1 compression ratio and a 10 : 1 blower ratio, reported to develop 450 hp. at 2,100 r.p.m. at an altitude of 6,000 ft. In addition to the increase in horsepower, the machine has been fitted with a ring-type cowl, and the nose cowling has been improved around the engine to give better streamline effects. Landing wheels, including the tail wheel, have been completely inclosed in streamline housings, and all exposed fittings have been provided with generous fairings. A special hand-rubbed finish has been given to all exterior surfaces to reduce skin friction. The general characteristics of the machine, with the exception of the change in horsepower ratings, are the same as those of the earlier Skyrocket models.

APPROVED TYPE CERTIFICATES

DURING the period Aug. 15 to Sept. 5 the Aeronautics Branch of the Department of Commerce issued the following Group I approved type certificates: 443, American Pilgrim 100A (Hornet B 575 hp.); 445, Cycloplane Cl (Cyclomotor A2-25 22 hp.); 446, Pitcairn Autogiro PCA-3 (Wasp Junior 300 hp.); 447, Aeronautical, Aeronca Cl (Aeronca E113 36 hp.); 448, Aeronautical, Aeronca C2N (Aeronca E113).

AEROLOGY, *by Lieut. C. J. Maguire, U. S. N.; McGraw-Hill Book Company; New York; 1931; 136 pages; $2.50.*

BOOKS on meteorology often err, from the point of view of the layman, either in going into involved mathematical theories of atmospheric phenomena or in simplifying the subject so much that they boil down to a few general rules for forecasting and reading weather maps, with almost no explanation of the underlying facts. Lieutenant Maguire, a graduate of Professor Rossby's course in aeronautical meteorology at the Massachusetts Institute of Technology and now aerologist for the Bureau of Aeronautics, has evaded both criticisms. His book is written in terms of observed phenomena rather than of partial differential equations, but the phenomena are discussed with reference to their causes. Only one chapter, and that a very short one, is given over to weather forecasting, while another, somewhat longer, discusses the construction of weather maps. Most of the author's attention was given to describing in simple and readable terms the relation between pressure, temperature, wind, fog, and precipitation, and such matters as the consistency of the tracks followed by storms. If Lieutenant Maguire's volume cannot be said to stand out as the one good book on the subject, for there have been other good ones from various points of view, at least it is one of the best.

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TASCHENBUCH DER LUFTFLOTTEN *(Pocket Book Almanac of Aeronautics) 1931; compiled by Dr. Werner von Langsdorff. (3 vol.,—military, commercial, and sport aircraft, respectively); J. F. Lehmanns Verlag;* Munich, 1931; 638 pages total; 8 Marks each.

THIS well-known annual appears for 1931 in three volumes, each a complete unit in itself and each covering a specific class of aviation. They are of convenient pocket size, being quite different in that respect from the classic "All the World's Aircraft."

The present annual differs from others, also, in being in three languages so that lack of knowledge of German need deter no one from using it. Each volume includes photographs and a standardized table of specifications of some 400 airplanes, together with a general specification index. The compilations are

The Nicholson Junior

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complete and well prepared, and an interesting and commendable feature is the inclusion of the name of the engineer directly responsible for the design in each case. The American section was prepared with the special assistance of A. A. Gassner, lately chief engineer of the Fokker Company, and Capt. A. W. Johnson, the Director of Naval Intelligence, and is very satisfactory except for a shocking number of misprints in names, and especially in initials. The three volumes are strongly recommended as a useful addition to every aeronautical library and to every engineer's personal reference collection.

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ELASTIC ENERGY THEORY, *by J. A. Van Den Broek; John Wiley & Sons, New York; 1931; 260 pages; $4.50.*

THIS text on the strength of materials goes more promptly, and much farther, into advanced methods than is conventional. It concerns itself especially with statically indeterminate structures, redundant frames, continuous beams, combined stresses, and methods dependent on analysis of deflections on energy considerations, such as the method of least work. A number of examples are used, and three of them are of specifically aeronautical interest, six pages being devoted to the analysis of a typical airplane fuselage, four to a consideration of the general stressing problems in a metal-clad airship (necessarily quite superficially considered and without reference to secondary failures), and ten to a consideration of a cantilever biplane with interplane struts like the war-time Fokker.

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REPORT ON THE EXPERIMENTAL REVISION OF THE ORDINANCE SURVEY PLANS WITH THE AID OF PHOTOGRAPHS TAKEN FROM THE AIR; *H. M. Stationery Office, London, England; 1927 and 1930 Editions.*

THESE documents present procedure and conclusions of two periods of experimental coordination of aerial mapping with the unusually exacting ground methods followed by the British Ordinance Survey, work which corresponds somewhat to the topographical mapping of the United States Geological Survey. The first report indicates that aerial surveys cost less and were more accurate than prevailing methods over towns in flat country, tidal areas, flats, mud and sand banks. The second, based on longer experiments with the air method, is less favorable. It is considered economical only in closely-built town areas and even here there are complications. It was found that all air work had to be checked on the ground in order to maintain the standards of the department. It should be emphazised that these maps show every detail even down to wire fences and partitions between houses, obviously detail beyond the range of an aerial photograph.

ELEMENTARY APPLIED AERODYNAMICS, *by T. G. Whitlock; Oxford University Press, New York; $4.50; 240 pages.*

THIS book is written to appeal to the student of aeronautical engineering, who is primarily interested in obtaining a working knowledge of the aerodynamics of airplane design and who usually is not sufficiently grounded in mathematics to be able to follow the applications of hydrodynamics to airfoil theory.

This makes it necessary for the reader to accept without analytical proof, several equations derived elsewhere. However, since a great deal of experimental evidence is given to check these relations, there is no great loss of rigor by the omission of mathematical derivations that are beyond the comprehension of the average engineering student.

The contents, briefly, are as follows: airplane nomenclature; the standard atmosphere; the airfoil in two dimentional flow; the air foil in three dimentional flow; airfoil combinations; parasite drag; performance estimation; equilibrium; stability; control; maneuverability; the propeller, and scale effect. An appendix giving the calculation of the angle of attack and the moment coefficient at zero lift is also included.

The book is well written and gains much in value because of the large number of illustrative problems which are worked out in the text. Moreover, at the end of most of the chapters there are problems to assist the student in applying the subject matter of the chapter. It suffers from a complete lack of references. Curves and numerical data are reproduced without any mention of their source. An inclusion of references would aid the student in collateral reading and would also give credit where credit is due.

The continuity of subject matter is also somewhat erratic. The introduction deals with problems the student would have trouble in understanding until he had read Chapters II and VI, the subject of the equilibrium of the airplane is partly dealt with in Chapter II, on airfoils, and partly in Chapter IX, and Chapter XII, on scale effect, should follow soon after the introduction, since experimental results are referred to constantly. In addition, there seems to be no reason why the subject matter of Chapters II and V should not be combined, since both deal with airfoils and since, for practical purposes, airfoil characteristics should be given in terms of two dimensional flow.—PROF. O. C. KOPPEN [*Massachusetts Institute of Technology*].

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CROSS-COUNTRY FLYING, *by Maj. Oliver Stewart; Richard R. Smith, Inc., New York City; $2.*

WRITTEN specially for the non-professional pilot, this book gives him the essentials in the art of finding his way across country under most conditions he is liable to encounter. Since cross-country flying problems have been Major Stewart's hobby since the earliest days of instrument flying while serving as a Royal Flying Corps ferry pilot across the Channel, the subject obviously is handled authoritatively and thoroughly. In fact, it perhaps goes into more detail on certain points than is necessary for his audience.

It is significant that a book on this subject has been prepared chiefly for the non-professional pilot, a recognition of the growing importance of this branch of aviation. Any pilot doing any serious cross-country work, but especially the non-professional, may derive much useful information from this volume.

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BEGINNING TO FLY, THE BOOK OF MODEL AIRPLANES, *by Merrill Hamburg; Houghton Mifflin Company, New York; 1930, 282 pages; $2.50.*

THE second edition of Mr. Hamburg's book has been brought up to date, and shows the result of his constant association with the model flying activities promoted by the Airplane Model League of America. Although the book is described as devoted to model airplanes, it attempts to qualify as a general manual by introductory sections on aeronautical history and on airplanes and engines. Both theory and practice of model construction are well covered, and descriptions of a dozen typical successful models are coupled with detailed instructions for building them. Suggestions for organizing model clubs and conducting contests and a little information on gliding conclude the volume. It is the best of its kind now available, and will be very useful to aeronautical people who, suddenly called on to aid the local Boy Scout troop in its aerial ventures, become aware of the grievous gaps in their own knowledge of how models are made to remain aloft for five minutes or more with the power of a twisted strand of rubber.

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STUNT FLYING, *by Capt. Richard Duncan; Goodheart-Willcox Company, Chicago, Ill.; 183 pages.*

THIS book is another treatise on the various steps in learning to fly. The aspects of stunt flying, for which the book is named, are dealt with principally in regard to old time exhibition flying of the daredevil type. This is rather out of place in modern aeronautics and the emphasis is quite surprising. The rudiments of seaplane, flying boat and amphibion operation are given in addition to those for land planes. As a matter of fact, stunt flying occupies only a comparatively small part of the text and the title is rather puzzling. It is not a particularly good presentation of either the real or the apparent subject.

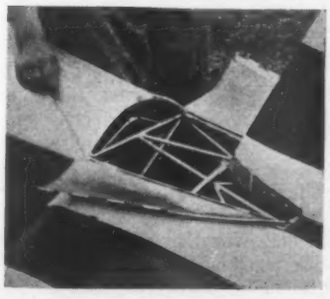
Design Novelties

Inspection doors for tail controls

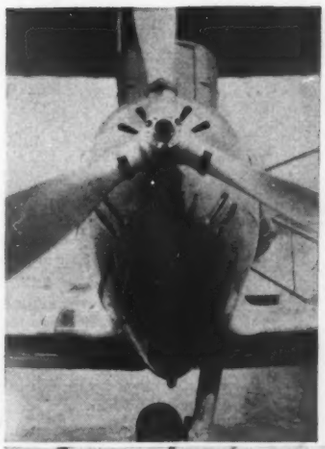
A SIMPLE and effective arrangement for the inspection and adjustment of tail surface controls is incorporated in the Messerschmitt monoplane flown in the German light plane tour for 1931. The after-portion of the turtle deck just forward of the fin is covered with a pair of metal covers, each hinged along the upper longerons, and meeting on the center line of the fuselage. By removing a straight metal pin the two sections may be thrown back over the top of the stabilizer, thus giving complete access to the after-portion of the fuselage.

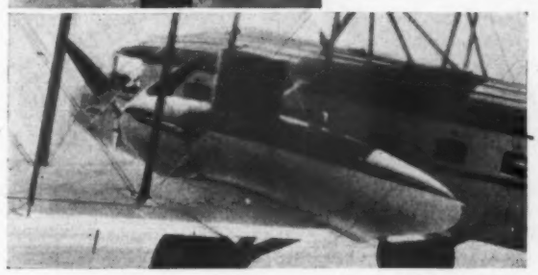
Jury strut on the Avian

BEFORE folding back the wings of the Avro Avian biplane for storage it is necessary to provide some means of preserving the alignment of the upper and the lower wings when the front spar hinges are detached from the center section and the fuselage. For this purpose, a jury strut is provided which is normally carried folded back along the lower surface of the upper wing near the point of attachment to the center section. It is made up of two pieces of steel tubing with a telescoping joint. Before unpinning the hinges of the wings it is swung downward and extended so that its lower end, which is pointed, engages in a shallow socket near the front edge of the walk-way on the lower wing. Internal threads are provided at the telescoping joint so that the strut may be put in sufficient compression between the upper and lower wing panel to preserve the alignment of the structure after the front hinge pins have been removed.



Messerschmitt monoplane inspection doors





The new nacelle of the Curtiss Condor

Improved streamlining for the Condor

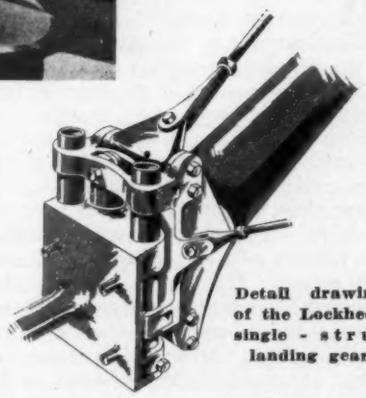
THE top speed of the new Curtiss Condors recently delivered to Eastern Air Transport, Inc., has been improved by 12 to 15 m.p.h. as compared with the older models by redesigning the nacelles housing the two Conqueror engines. When this machine was adapted for transport use from a design intended as a military bomber, the engine nacelles were but slightly modified, although each originally had provision for a machine gunner's cockpit in the tail.

The new nacelles are somewhat longer, but not quite as deep as their prototypes, and have been designed without regard for military precedent. They have been beautifully streamlined from nose to tail, and provided with generous fillets where the connections are made to the lower wing. The original radiator location has been retained.

A single strut landing gear

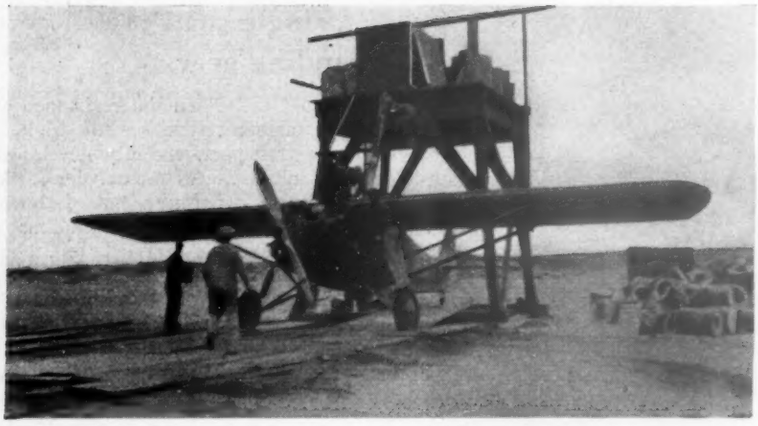
TO CUT down the resistance of the undercarriage on the high speed Vega transport, recently developed for the United States Army, the Lockheed Aircraft Corporation has designed an interesting single strut landing gear. Each wheel is carried on a single streamlined strut braced to the fuselage with four sets of streamlined tie rods. The strut, itself, has no shock absorbers.

The wheel, which carries a standard brake and a large low-pressure tire, is assembled on an axle mounted on a steel forging. The latter is in the shape of a square block; and incorporates a shock absorber unit. Parallel with, and on either side of the shock absorber unit, two short tubular members are mounted so that they pass through lugs on the wheel block and also through lugs in a forging attached to the end of the rigid landing gear struts. When assembled, the tubular members act as connectors between the wheel block and the fixed strut, but permit an up and down movement of the wheel with respect to the strut. The vertical movement is controlled and limited by attaching the free end of the shock absorber unit to the strut fitting. The entire wheel assembly has, therefore, freedom to move up and down against the resistance of the shock absorber unit. The energy to be absorbed in landing is distributed between the low pressure tire and the shock absorber.



Detail drawing of the Lockheed single - strut landing gear

Aircraft at Work



Loading tower and plane on beach base

Dusting used effectively against timber pest

AN unusual airplane dusting operation recently conducted in the state of Washington has brought excellent results in the attempts to eradicate the "hemlock looper," a destructive insect pest. Northwest Air Service, Inc., Seattle, was commissioned by the Washington timber interests in May to make an aerial map of the infested area. This map showed that the infested trees were not in one stand but were distributed in patches over an area of approximately 20 sq.mi. The area to be dusted included 5,400 acres, mostly in three large areas and a number of small patches.

The terrain affected is rugged, varying in altitude from sea level to 2,500 ft., and badly cut up with ravines. The forest cover is very irregular, many extremely high spruce trees being scattered among the hemlock. This made dusting both difficult and dangerous as it was necessary to fly close to the trees in order to dust them satisfactorily.

The plane was a converted Ryan Brougham equipped with a special hopper agitator driven by an electric motor operated from a storage battery. Dusting was done by John R. Blum, president of Northwest Air Service, and by Wesley Gray. Since the affected timber was located near the coast, a beach landing field was used. A hopper on a tower on the beach was loaded from cans of chemical while the plane was in the air, and the mixture was dumped directly into the plane hopper on its return. Fifty-four tons of calcium arsenate, containing a 41 to 43 per cent solution of oxide of arsenic were used. The plane carried from 900-1,000 lb. of this material on each trip.

Dusting required fourteen days; 117 trips were flown and time in the air totalled 53 hours, 9 min. The average time on the ground between landing and take-off was 8 min. There were no mishaps.

The results were: 60 per cent kill the first day following the dusting, 10 per cent additional kill in the next two or three days, and it was believed that the dusting would account for an additional kill of about 5 per cent, or a total kill of 75 per cent. The average cost per acre was $2.90.

Fast air survey made in Canada

THE Aerial Survey division of Canadian Airways completed last winter a set of contour mosaic and oblique photographs and other data for use in engineering a new construction project of Algoma District Power Company at the sparsely settled mouth of the Montreal River on Lake Superior. An extremely accurate contour map was produced and the time required was comparatively short.

The contract was signed Sept. 19, 1930. The photographic crew—consisting of a pilot, photographer and air engineer and using a Fairchild 71, Fairchild 12-in. camera, two magazines, view finder and vertical and special mount—arrived at the Sault Ste. Marie base on Sept. 22 after a 600-mile flight from Montreal. The photography was completed after 2 hours 30 min. flying Sept. 25, and the plane was recalled Sept. 30, no re-takes being necessary.

The two rolls of films were developed and printed Sept. 27-30, and between Oct. 3 and Oct. 8 a small relief model in plasticene was completed from stereoscope inspection of prints.

Contour work and the permanent mosaic could not be advanced until the receipt of horizontal and vertical control point data from the client Dec. 12. This data involved field survey.

The actual contouring took until about the middle of February. The finished mosaic was completed March 6, representing a lapsed time since the signing of the contract of five and a half months, two of which were consumed in obtaining control plans. As a result of this experience it appears that the preliminary mosaic may be of great value to the client for ground work in connection with such activities as location of camps and transportation routes, and for use of field parties in gathering the necessary control data. Such maps may be made within three or four weeks.

Buhl Pups used in fly-it-yourself plan

TWO Buhl Bull Pups have been used during the past season by Midwest Airways, Milwaukee County Airport, in a successful fly-it-yourself service. One has been flown 300 hours and the other 200 hours at the rate of $0.10 per mile. On the basis of 76 m.p.h., these two planes have earned a total income of approximately $3,800 while the operating cost, figured at about $0.01 per mile, has totaled about $380.

Very little repairing has been necessary, the company reports. The service has accounted largely for the increase in business experienced by the company this year. An increase of 35 per cent in student enrollment over a year ago, bringing the total enrollment to about 150, is considered due directly to the service, while a 25 per cent increase in general charter flights has been attributed largely to general interest stimulated by the innovation. The hourly rate has been reduced since Labor Day, from $7.60 to $6.

Students are instructed and soloed on Fleets. After a few hours solo many begin flying Buhls to accumulate time. Most of the patrons are non-professional pilots with a private license.

Airport Management

Garages for patrons add to port revenue

AN ADDITIONAL source of revenue has been developed by the San Francisco Bay Airdrome, Alameda, Cal., through the provision of individual garages for the use of airport employees or airline passengers. Six garages are now in operation. One garage is reserved at all times for the use of transients and air travellers. Three more are now being erected and others will be provided as required.

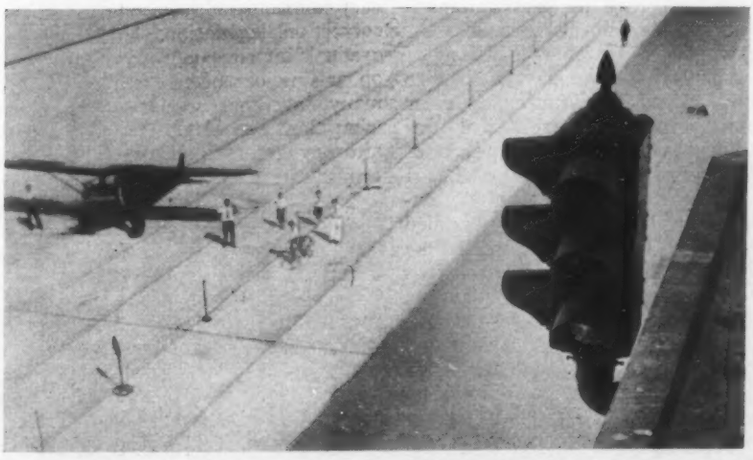
Transient customers pay a rental fee of 50 cents per night or $3 per week. Field employee tenants pay $5 per month. The garages are protected by night watchman service. Building each garage as a separate unit lowers the fire hazard appreciably and simplifies provision of additional units.

Six garages at the San Francisco Bay Airdrome

Street signal lights control airport traffic

THE New York Municipal Airport —Floyd Bennett Field—has borrowed a regulation traffic signal from from its police department for control of ground traffic on the port. This installation has the green, amber and red lights on three faces, pointing out toward the main runway, which lies at right angles to the broad concrete taxiway along the hangar line, and in both directions along the taxiway.

A red light seen from any point along these surfaces halts all traffic in that direction. A green light permits movement along the strips, and take-offs. Control is from the tower atop the administration building where an attendant is on duty at all hours. This adds another interesting traffic control experiment to those under study by the Aeronautics Branch and the Aeronautical Chamber of Commerce.



The street traffic signal in use for runway and taxiway traffic control at Floyd Bennett Field

A service plan for private owners

THE Curtiss-Wright Airport at Valley Stream, L. I., is developing its non-professional business by a new plan of customer service. The management believes in the potentialities of the non-professional business and is taking aggressive steps to cultivate it.

Lower hangar rates is one of the new features. Formerly rates ranged upward from $40 per month, but it is now possible to house a three-place Travel Air or a Challenger Robin for $35 a month and the Curtiss Junior for $30.

Not only are these rates lower, but they include more service than has ever before been granted as part of the rental. Machines will be kept washed, will be taken out on the line and warmed up on notification, and, when so desired, will be delivered to any airport within the metropolitan area the owner desires without an additional charge.

If, for instance, an owner happens to be in Westchester County for a week-end and wishes to fly, he need but notify the airport by telephone the time he wants his plane delivered to the airport at Armonk. The machine is delivered there on schedule and is called for when the owner is through with it.

This service is possible through co-operation of the flying school. Students taking cross-country training pick up the company pilot at an airport where he has delivered a plane. This provides the student with one cross-country trip solo and one with a passenger for each delivery. The reverse occurs on a pick-up after the owner is through with his plane; the student flies the instructor to the airport and departs solo while the instructor returns with the machine of the private owner.

Another important feature of this plan is the club atmosphere involved. All privately owned craft are housed in one hangar; the owners will have their own lockers and there will be a lounging room with reading matter and comfortable furniture for their convenience. This will be in charge of the chief mechanic. Other hangars will be reserved for exclusive use of the private owners as the need arises. At the outset seventeen planes are being housed in hangar No. 3 of the Curtiss-Wright port at Valley Stream.

What Our Readers Say

"The Patent Racket"

To the Editor:

Your recent editorial "The Patent Racket" appearing in the August issue of Aviation strikes one as an appeal in a direction that will do a lot of good. It is a condition that should have improved long ago. The suggestion that national engineering societies could pass on the practical merits of ideas submissted would appear to offer an admirable basis for solution. Such organizations could no doubt furnish to inventors with names of reputable patent lawyers versed in the aeronautical art. It might go further listing reputable attorneys in the respective fields specialized.

The class of inventors to which the editorial refers are as a rule quite ignorant of the value of patents. They lack knowledge of Patent Office procedure. While this information may be secured from the Office, because of detail it is apt to be found confusing. Information presented to the inventors in clear terms giving him an outline of patent office procedure the importance of properly preparing the patents and the usual necessity of lengthy prosecution in the patent office to insure adequate claims would be most beneficial. A number of texts which treats the matter fairly comprehensively could be recommended.

While very few patents have any value there are often inventive ideas disclosed in patents that might have helped inventors had the patents been properly obtained. The subject merits a great deal of attention because the problem is so far-reaching; not only to inventors with conceptions in the so-called freak class, but I believe you will find professional men at the mercy of unscrupulous lawyers. Perhaps a fund or endowment could be obtained to carry on such important work. It doesn't so much matter whether it be in the hands of engineering societies or university extension work or a philanthropic enterprise. Although the former as stated in the editorial has the machinery to function.

Randolph F. Hall
Rochester, N. Y.

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To the Editor:

Your editorial on "The patent racket" in the August issue is a timely one.

The practices complained of, that of taking out patents on obviously inoperative structures, not only cause considerable loss to the deluded inventors, but bring the patent profession into disrepute. Fortunately, the guilty attorneys can readily be located, since usually the name of the attorney appears on the drawings which form part of the patent, and when it does not so appear it can be obtained from the patent file in Washington.

Another group to blame, it seems to me, are the Patent Office examiners who permit such patents to issue. The examiner is supposed to be skilled in the art, and it is his duty to reject an application for a patent on a structure which will not operate to perform the functions it is asserted to perform. If instead, a patent is granted, it is likely to be taken as a certificate that the structure is operative, and thus possibly it may assist in fraud.

Ray T. Ernst,
Knight Brothers
New York City

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To the Editor:

I have read with great interest the editorial entitled "The Patent Racket" in the August issue of Aviation.

In the first place, few patent lawyers advertise, for it is unethical for the patent lawyer to do so. There are firms of patent attorneys, chiefly in Washington, who advertise, but the majority of their clients include inventors in remote parts of the country who do not have direct access to the office of a patent attorney.

In the course of our practice, I very frequently endeavor to convince inventors in many different arts, and particularly in the art of aviation, that their inventions are impractical, and I have referred such inventors to apparently reputable consulting engineers. Invariably the inventor is suspicious of such advice, and there has been more than one case of a consulting engineer utilizing in an improper manner information obtained from a client of ours. I do not wish to infer that I know of many cases of consulting engineers who have improperly availed themselves of information supplied by clients of ours referred to them. Even one such case, however, has an effect on the client which is vary difficult to overcome.

When we are requested to file a patent application for an invention which appears to us to be physically impossible or grotesque, we first advise the client that such is our opinion. Very frequently the inventor replies that he has actually tried out the contrivance in secret, and that it works. Then there is nothing left to do but file the patent application. Otherwise the inventor, after he has been so advised, usually takes his departure in ominous silence.

If an inventor wants to apply for a patent, regardless of the merits or demerits of his alleged invention, the only way to convince him of its merits or demerits is by a final action on his patent application by the Patent Office or an appellate body. After all, this is as it should be becouse the history of aviation, as well as the history of all other practical arts, is full of theories held impractical for years and finally universally adopted.

In other words, our patent system taken as a whole is a vast clearing house of ideas, and it is a matter of record that the practical solution of many problems has been attained by wise selections here and there in the prior art of impractical patents. So after all, the impractical patent is of some value.

We must not forget on the other hand, that the most successful practical inventors are men who combine unusual business ability with the courage to defy that which has been common practice in the past. Research organizations account for most useful improvements on pre-existing basic ideas, but there are few examples of any revolutionary inventions coming from such organizations.

Returning to the alleged "Patent Racket", every applicant for a patent is exercising a direct right conferred by our Constitution and statutes. The patent attorney merely helps the inventor in exercising these rights, and even though he may have decided opinions as to the merits of any particular invention, his ultimate duty is merely to carry out the instructions of his client. The patent attorney is very rarely able to pick and choose his clients.

The patent profession as a whole is constantly endeavoring to circumscribe the activities of its black sheep. It is very difficult to get Congress to pass corrective legislation, but there is a gradual improvement constantly going on arising out of the fact that a great many inventors sooner or later learn what they should expect from a patent attorney, and seek out the attorneys who render the proper service.

H. F. Frease
Frease & Bishop, Patent Lawyers
Canton, Ohio

[We recognize the reputable nature of the practice of patent law in the case of the vast majority of attorneys that engage in it, but there are a certain number of black sheep who put a stigma upon the while profession. It was of course only of those lawyers that we were speaking in the editorial about which Mr. Frease writes.—Ed]

Servicing Short Cuts

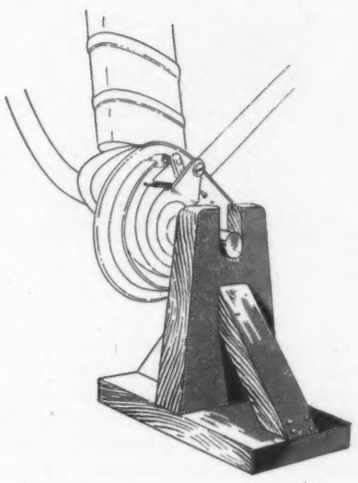
A PORTABLE BARREL FOR OIL DRAINAGE

REMOVING old oil from airplane engine crankcases with little effort and without danger of spilling the drainage on hangar floors has been accomplished in a practical way in the Hexhanger servicing unit of the Transcontinental and Western Airways at Alhambra, Cal., by mounting an ordinary 40-gal. oil drum on a small dolly. The drum is fitted with a special receiving funnel to catch the oil from the tanks, and with a special pipe outlet and valve at the bottom for draining the oil into an underground receiving tank. A simple float gage mounted on the side of the barrel calibrated in quarts makes it possible to read the exact amount of oil drained at any one time. It is reported that the use of this equipment effects an average saving of four man-hours a day over the older method of draining into individual containers and carrying away by hand.

WHEEL AND BRAKE SERVICING

FOR minor adjustment of bearings or brakes on the landing gear of the Curtiss Kingbirds, used on the Southern Division of Eastern Air Transport, Inc., the side of the undercarriage in question is simply raised clear of the ground by means of a hydraulic jack. In cases where the wheel must be removed, a solid, well-braced wooden supporting block is pushed under the free end of the axle and the jack lowered until the weight rests entirely in the support. By reason of its broad base, the support carries the weight without danger of tipping over when other work is being performed on the plane, and the jack is released for other uses in the shop until the wheel is ready to be remounted.

Through the use of such simple and inexpensive specialized equipment, well organized repair shops are promoting safety by the elimination of haphazard methods, with their attendant risks.



Wheel removed, axle on support

Portable drainage barrel

AN EMERGENCY CRASH KIT

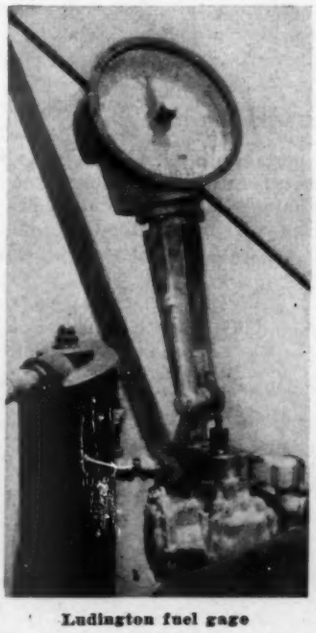
AN EXCELLENT emergency crash kit has been developed by the Boeing Airplane Company, and is kept available in its hangar on Boeing Field, Seattle. The kit weighs about 60 lb. complete and is equipped with handles so that it may be easily carried by one or two men. The tools include hammer, crowbar, metal shears, heavy wire and iron bar cutter, adjustable wrench, saw, axe, and sledge hammer. Mechanics are forbidden to use them for routine work lest they prove to be unavailable when required in an emergency.

PRESSURE SYSTEM FOR LUBRICANTS

HANDLING of oil and grease is greatly expedited in the Seattle shops of United Air Lines by placing the storage tanks under air pressure so that lubricants may be drawn off at will by merely turning the proper air valve. Two 55-gal. oil tanks, and a grease tank holding 50 lb., are now installed. By application of air pressure to the storage taks, oil pails or grease guns can be filled with great rapidity.

AIRPORT FUEL GAGE

FOR convenience in making accurate and rapid reading of the amount of fuel pumped into the tanks of the Stinson airplanes at the Washington shop of the Ludington Lines, a new Wayne gage has been added recently to the fuel pumping unit (AVIATION, June, 1931). The dial is approximately 1 ft. in diameter and is tilted at such an angle that the mechanic filling the tanks high up on the wing of the airplane has a full view of it. The letters are large and can be read easily from any distance within the length of the filling hose.



Ludington fuel gage

The Buyers' Log Book

Tensiometer

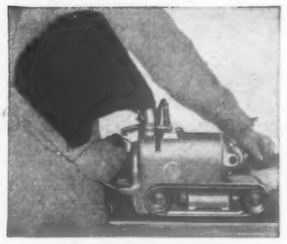
A new tensiometer designed to give direct reading in pounds of the tension on wires or cables has been announced by the Hills-McCanna Company of Chicago. The instrument is hooked on to the cable in any position, and the center bearing tightened to deflect the cable. A reading is taken in pounds directly from the scale without making calculations or allowing for temperature corrections. No wrenches or tools are required for the operation.—AVIATION, *October, 1931.*

Sheet metal former

A machine designed to reduce the cost of forming metal aircraft parts by eliminating the necessity for a heavy investment in dies has been developed and put on the market by the Engineering & Research Corporation, 2014 Fifth St. N.E., Washington, D. C. The forming of the metal is accomplished in a manner similar to that which would be used in hand fabrication, but the hand hammer is replaced by a short brake which oscillates approximately 250 times per minute. The forms employed with the machine are very simple and are said to be no more expensive than those required to fabricate corresponding pieces by hand. The machine will handle sheets in thicknesses up to .083 in. in annealed strong aluminum alloys of practically any length. It is driven by a ½-hp. motor and controlled by a foot treadle.—AVIATION, *October, 1931.*

Dustless sander

A portable sanding machine in which is incorporated a vacuum system for continuous collection of dust has been developed by the Porter-Cable-Hutchinson Corporation of Syracuse, N. Y. A



A dustless sander

small suction fan, driven directly by the sander motor, collects the dust as rapidly as it comes from the belt and delivers it to a bag similar to those used on the ordinary household vacuum cleaner.—AVIATION, *October, 1931.*

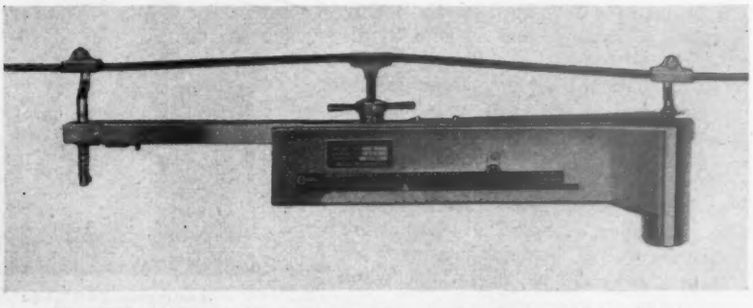
Portable amplifier

A portable public address unit is now being marketed by the Operadio Manufacturing Company of St. Charles, Ill. The unit is compactly assembled in a single carrying case, the front of which forms a baffle for the dynamic speaker. Space is provided for all accessories, including microphone and connecting cord. The unit operates on the usual 110-volt, 60-cycle lighting circuit. It is stated that as many as four additional loud speaker units may be operated from the amplifier.—AVIATION, *October, 1931.*

Paint shop cabinet

A steel cabinet especially designed for the storage of paint shop equipment has recently been announced by the Lyon Metal Products Company of Aurora, Ill.

Sheet and strip metal former. Below: The Operadio amplifier



The Hills-McCanna tensiometer. Above: The Lyons paint cabinet

The cabinet is 34 in. wide, 24 in. deep and 78 in. high and includes specially designed and reinforced shelving to store the complete individual equipment of a spray booth operator, including everything from 5-gal. cans to spray gun and masking paper. The shelf immediately above the single drawer may be used as a mixing board as all higher shelves are only half depth. Full length double doors equipped with three-point locks are provided.—AVIATION, *October, 1931.*

Short-wave receiver

A new short-wave aircraft radio receiver has been placed on the market by Radio Laboratories, Inc., Los Angeles, Cal. The set is said to have a range of 1,500 miles when receiving from a 400 watt transmitting station. It weighs 6¼ lb. complete and measures 13½x8x4 in. overall. It is powered with a special Eveready aircraft battery and operates with a simple antenna arrangement. It is compact enough to be installed directly in the pilot's cockpit, thus eliminating remote control.—AVIATION, *October, 1931.*

Catalogs

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Elgin Aircraft Instrument Division. A new catalog has been received from Elgin (Aircraft Instrument Division) of Elgin, Ill., covering their complete line of aviation instruments. There are included not only a general description, but also installation data and drawings for each instrument.

Cleveland Electric Tramrail. A new 400-page catalog recently published by the Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Company of Wickliffe, Ohio, describes fully the equipment and application of tramrail systems for overhead handling of materials or machines. Equipment of this type has application in aircraft repair shops and hangers.

Colas Roads, Inc. The application of "Colas" as a surfacing material for roads and airport runways is described in a new illustrated bulletin recently published by Colas Roads, Inc., of 2201 Pershing Square Bldg., New York City.

Technical Abstracts

COMPRESSION RATIO IN THE DIESEL

THE LIMITS OF COMPRESSION RATIO IN DIESEL ENGINES, *by D. R. Pye; Aeronautical Research Committee R & M No. 1365.*

VERY extensive researches have been carried out in the past on the effect of compression ratios on the performance of gasoline engines. So thoroughly has this work been done that by now the effect is well understood. The corresponding effect of changes in compression ratio on the efficiencies of high compression, injected fuel engines does not yet seem to have been thoroughly investigated.

As a first investigation, the British Air Ministry, through its Aeronautical Research Committee, carried out a series of tests with compression ratios of 12 to 1 and 15 to 1 and combined these experimental results with calculated efficiencies for ratios of 10 to 1 and 20 to 1, an assumption being made as to the maximum pressure to be allowed in the cylinder.

Although the limit of compression ratios in gasoline engines is taken at roughly 6 to 1, engines using the diesel cycle require a compression ratio of not less than 10 to 1 in order to insure ignition of the fuel. This lower limit seems well agreed upon—a thing which cannot be said of any upper limit. The problem of achieving high efficiency in a heavy oil engine takes on a rather different aspect from that which it bears in a gasoline engine. In the diesel engine there is no great difficulty in obtaining extremely high thermal efficiencies at low values of the mean effective pressure, and the problem which faces the research engineer and designer is that of extending these high efficiencies, proper to the high compression ratios employed, up to M.E.P.'s comparable with those customary in a gasoline engine at full load. There appears to be some danger that concentration upon this aspect of the problem and upon the necessity of burning as much air as possible without allowing excessive maximum pressure, may obscure the importance of using high compression ratios if the best economy is to be obtained.

From the consideration of the experimental and calculated curves and the way they have been derived, it is concluded that there is evidence that substantial gains of economy may be achieved by a raising of the compression ratio to 15 to 1, provided difficulties of design in regard to the shape of the combustion chamber can be got over; but that an examination of the theoretical cycles makes it appear unlikely that any advantage would be obtained by raising the compression ratio further, so long as maximum cylinder pressures are limited to about 900 lb. per sq.in.

SEAPLANE TAKE-OFFS AND LANDINGS

TAKE OFF OF SEAPLANES BASED ON NEW HYDRO-DYNAMIC REDUCTION THEORY, *by Paul Schröder; N.A.C.A. Technical Memo No. 621.*

IN CONSIDERING the take-off characteristics of a seaplane hull, the lifting forces due to the water displacement by the volume is negligible. The dynamic forces can be treated in a manner similar to the way in which the lift and drag characteristics of airfoils are treated. Schröder in this paper seeks a variable against which lift and drag properties of seaplane hulls can be plotted just as airfoil characteristics are plotted against angle of attack. The mathematical derivations seem logical and a resulting formula indicates that plots of

$$\frac{\text{drag}}{\text{lift}} \text{ vs. } \frac{\rho}{2}(\text{width})^2 \frac{(\text{velocity})^4}{\text{drag}}, \text{ and}$$

$$\frac{\text{moment}}{\text{width}} \text{ vs. } \frac{\rho}{2}(\text{width})^3 \frac{(\text{velocity})^3}{\text{drag}}$$

should between them give all the desired take off characteristics.

It must be born in mind however that these values only are valid when the hull is planing and assume that no structural part of the seaplane is causing additional drag.

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LANDING OF SEAPLANES, *by Herbert Wagner; N.A.C.A. Technical Memo No. 622.*

THIS paper, originally published in Z.F.M. Jan. 14, 1931, is an attack on the problem of seaplane impact, stressing the forces resulting from velocities and momentums set up in the water by the hull. From this approach several formulas are worked out and examples carried through for several different cases. First, a flat keeled bottom and one having twice as much keel; and then for two particular hull shapes, one with constant keel angle, the other with this angle varying.

Some of the results are of general interest. For equal take-off ability a wide boat is subjected to lower impact pressures than a narrow one so the first blow does not produce exorbitant stresses on the aircraft although the actual bottom construction will become heavy because of the greater width. Also the duration of forces on the wide boat is greater with the result that the total retardation is more than for the narrow boat, and it is therefore liable to be tossed up more by the wave and its own forward speed.

Side Slips

By ROBERT R. OSBORN

Report of the National Air Races by Side Slips' Special Correspondent, with the annual and probably unnecessary apologies to Mr. Ring Lardner.

DEAR EDITOR: Well Ed you has probably seen by the papers already how I an my assistants has put over another successful Nat'l Air R'ces. Maybe I hasn't been mentioned so often in the New York papers on account I always giving most of the credit to my assistants when interviewed an this might be a good opportunity for me to thank Mr. Cliff Henderson an Mr. Grieve an the rest for there efforts on behalf of the industry. I don't want you to worry when you don't see in the papers I am here an on the job, as on account my usual very retiring disposition I prefer to remain in the background and award all the credit to them what helps out. However as an example of how well my Nat'l Air R'ces organization is smoothly running now, I was not able to get here at the beginning of the affair an yet matters went off very nicely but not quite as well a course. The largest crowds turned out when it finely got about that I was to be present the last of the week, but a course I was there to handle them at that time.

One thing what always gives me great faith in the old industry as I has jokingly nicknamed it, is that the boys always manages to turn up at these races annally, no matter how far away they is an no matter how bad the depression is. A course it must be admitted that most of them was there this year to look for jobs but what an th'hell says I, we're glad to see them anyway. They was all on deck in the lobbies of the hotels looking as prosperous an happy as ever but they was one good indication how bad times was with them. When we asked them which hotel they was staying at they would all say they was staying with friends in the country but I notice some of them slipping around the corners in the direction of the freight yards when the parties was over.

The outstanding feature of the show was the Thompson Trophy Race what I has jokingly nicknamed the Speed Classic of the Air for America. The racers entered versus this race was absolutely amazing on account they having no wing area at all, well, hardly any. My prophecy that we soon will have fins cast on the crankcase for wings was almost realized this year. When I first seen these ships I was reminded about the fellow what applied for a job as a life guard at a beach an they asked him could he swim fast an he says he can't swim at all but he can wade like hell. When I seen this Gee Bee job what won the trophy I says What, have they a taxiing race this year but it seems these ships could actually take off an land in the same county. An what's more Ed is when they do take off they is going places from then on. The rumor reached my ears that the Gee Bee pilot could cut his take-off in half by holding his hands out like wings, thereby doubling his wing area an making a biplane out of it but I don't know if that is so. You never know what to believe at the races.

During this same Thompson Race Red Jackson flew threw a tree an busted part of his wings. It is not known if he was trying to clip a couple of wings off an make a monoplane out of his Laird for the rest of the race or was he just picking up a couple of apples to amuse hisself with. In any cases I take this opportunity to complain about this low flying what is practiced during the races. On Sunday I an a taxi driver in a Yellow Cab was about to pass a gate in a fence when a monocoupe come through the gate an beat us to the crossing, an the only reason I knowed it was a monocoupe was no other ship would fit through the gate. Now in a hand to hand encounter I'd bet on the yellow cab against any two monocoupes but if we'd been a second sooner it would have been a mussy job explaining matters to the police officer at the gate how come we went ahead when he had give the whistle and the nod to the monocoupe. The place for an airplane is in the air says I and let them make up their minds are they racing or wandering about amongest the shrubbery.

You know Ed, It has been a time honored custom that the timers always spends the entire races at the hot dog stands and how and the h--l they ever makes up the times for the races is by matching or picking numbers out of a hat or somehow, who knows. Well, one of the innovations this year is that now the hot dogs is delivered to the timers by messenger boys which is a vast improvement on account they get a better view of the races. The system on the timing is the same though an goes something like this. Mr. Underwood says to Carl Schory, Carl guess what number I am thinking of an that'll be Bayles time for this race, an Carl says Bayles, what Bayles? and Mr. Underwood says why the Bayles what is entered in this race we are running, an Mr. Schory says Oh are we running a race and you never can rely on those announcers why didn't they tell me. An so it goes an finely Miss Fisher decided who would win the race on account she likes his looks an types off a press flash an rushes it off to the press box. This incidently explains why so many good looking single fellows win the races this year, and we suppose it is as good system as any, certainly as good as the Ford tour formula.

They had a very intricate pass system working this year as per usual an one indication how bad it was I had to tell a usher a couple times who I was before he'd let me in places. Why during the jumping-to-a-mark contests a couple of parachute jumpers got throwed outen the grand stand where they landed on account they didn't have tickets for those box seats. However I suppose they has to keep the public an chislers out and I am willing my moving about should be hampered a bit. In any cases the college boys they hired as ushers was better than soldiers with fixed bayonets or Pinkerton men with blood in their eye, an who can think of anything else to do with college boys after all?

One of the indications of bad times was Casey Jones doing a daily fainting act in front of the microphone instead of racing his clipped wing oriole or a robin or something, an Frank Walton, aviation editor of the N. Y. Herald Tribune is forced into writing novels. At first I was suspicious of Dick Depew too, on account he being seen busy with his sleeves rolled up working on ships. Closer investigation, however, showed he was making fairings outen modeling clay, on ships which strangely all had American Ranger engines. Tommy Thomas, the pride of the Pacific Coast was goin about admitting his business was good, but only when cornered on the question. He always spoke in a low voice when admitting things was OK with him on account the danger of being bopped by an irate eastern sales representative.

Al Williams an his foreign boys sure put up a good show an I reccommends they all take out citicenship papers, except Al, a course. This fellow Atcherley ought to be a permanent fixture, so long the Curtiss Fledglings hold out as his show is a prize.

Well, Ed, this was a fine show this years an in conclusions I wish again to thank all those what helped me put it across. Next year we'll do better than ever and I hopes all the boys still has friends in the country where they can stay, as it will be a bad day for aviation when they fail to show up.

Y'rs v'y Tr'ly
THE INTREPID AVIATOR.

Pennsylvania Railroad Puts 150 New Electric Locomotives On Timken Bearings

150 of the electric locomotives to be built for the Pennsylvania Railroad's New York-Washington electrification project will be equipped with Timken Bearings on all driving wheels and engine truck axles.

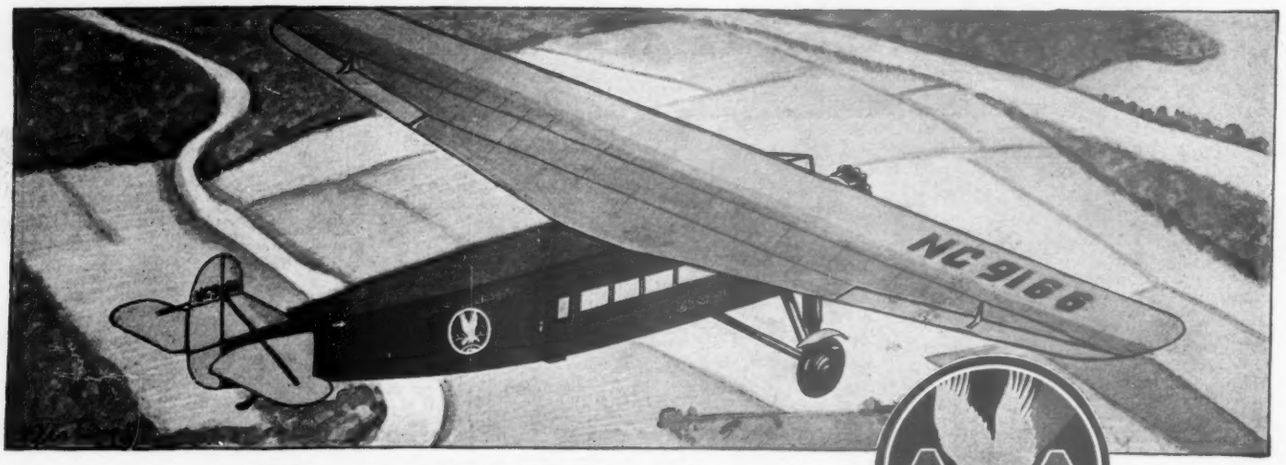
90 of these locomotives will be of the P-5 class, 3,750 H.P., designed for a speed of 90 miles per hour in passenger service. The other 60 will be of the L-6 class, 2,500 H.P., for freight haulage.

The selection of Timken Bearings for this important new equipment foreshadows the universal use of anti-friction bearings on all types of locomotives and railway rolling stock.

This is the largest order for anti-friction bearings ever placed by any railroad at any one time. The Timken Roller Bearing Co., Canton, Ohio.

TIMKEN *Tapered Roller* **BEARINGS**

TEXACO AVIATION GASOLINE FOR AMERICAN AIRWAYS, INC.



Today one can travel by American Airways planes comfortably from New York to Los Angeles in 29 flying hours.

THE Southern Lines of the American Airways use Texaco Aviation Gasoline exclusively at terminals from Atlanta to El Paso.

The American Airways operates a nation-wide system of air transportation for passengers, express and the United States mails. Its planes are of the most modern type, superbly designed for the safety and comfort of passengers. Pilots are in constant touch by radio en route with 200 government weather stations and 65 special American Airways stations. Unusual airport inspection facilities are provided to insure safe arrival at destinations and unbroken schedules.

In line with this high type of service, twenty-four of the American Airways' Southern Air Terminals are stocked exclusively with Texaco Aviation Gasoline. The operating staffs at these terminals are enthusiastic boosters of Texaco Aviation Gasoline.

This super-power gasoline is available at the Country's principal airports and landing fields from coast to coast.

THE TEXAS COMPANY, 135 East 42nd Street, New York City

TEXACO AVIATION GASOLINE
TEXACO AERODIESEL FUEL
TEXACO AIRPLANE OILS
TEXACO MARFAK GREASES
TEXACO ASPHALT PRODUCTS
FOR RUNWAYS, HANGAR FLOORS AND APRONS, AND DUST LAYING.

DON'T
FLY ANOTHER WINTER *WITHOUT* AIRWHEELS

MOST of the year's worst weather comes in the next five months.

You may be able to pick your ground conditions at the start of a flight—but nobody knows what you'll find when you come back to earth again.

Play safe—with the only wheel and tire equipment soft enough to land safely on mud or snow. Equip yourself with Goodyear Airwheels.

The cost of Goodyear Airwheels and the new Airwheel roller bearing brakes is almost exactly the same as you'd pay for wheel and tire equipment far inferior in safety.

They're worth having, just for their protection in emergency landings—but they mean easier flying, and they save your ship in everyday service.

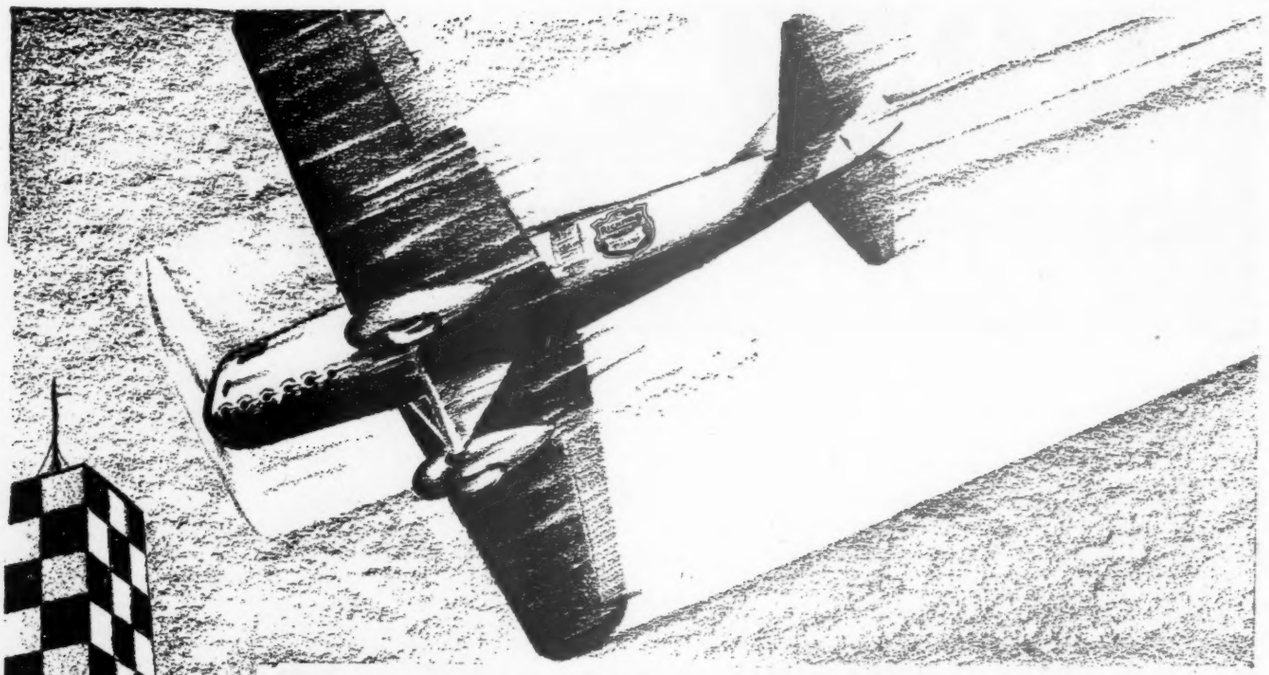
Ground loops are almost impossible—you can get far better take-offs and landings with Airwheel brakes—cross-wind or down-wind landings are easy—you save your ship from the vibrations of taxiing over rough fields—when you have these big, soft, rolling rubber pillows between you and the ground.

Only Goodyear can give you Airwheel safety. For full proof of what Airwheels can do—write to Goodyear, Akron, Ohio, or Los Angeles, California.

WHEN YOU BUY A NEW SHIP SPECIFY GOODYEAR AIRWHEELS

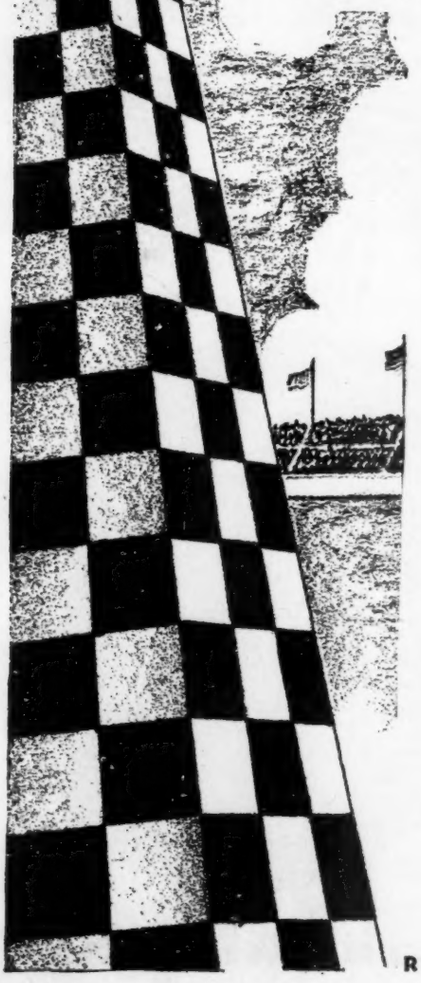
GOODYEAR

EVERYTHING IN RUBBER FOR THE AIRPLANE



The Most Sensational Performance in the History of the Air Races . . .

Richfield Wins the 3 Major Events with a New World's Record in Every One!



THE Thompson Trophy Race won by Lowell Bayles; the Aerol Trophy Race won by Maud Tait; the Invitational Free-for-all won by Robert Hall. All...won with Combat Richfield Aviation Gasoline. Bayles' speed of 236.239 miles per hour exceeds all existing records for a land plane over a closed course...and topped the previous world's record made only the day before by Robert Hall in the Invitational Race by 14 m. p. h. Miss Tait set a new world's record for women of 187.574 m. p. h.

That...and numerous other closed course events credited to Richfield products...sums up Richfield's brilliant performance at the National Air Races this year. It indicates the wide margin of victory over all other gasolines; no other motor fuel even remotely approached this record during the races.

Since the inception of the National Air Races...Richfield has been the outstanding winner among gasolines. It *must* be a superior product to enjoy the preference of pilots who are capable of new world's records...smashing victories in these world-famous tests of speed and stamina.

Use Combat Richfield for your own plane...get this superior performance...at important airports both east and west of the Mississippi.

COMBAT
Richfield's Aviation GASOLINE

RICHFIELD OIL COMPANY ◇ LOS ANGELES ◇ NEW YORK CITY

Pratt & Whitney Engines Gain a Lap in Leadership at 1931 National Air Races

Climaxing a series of performances that brought new honors to Pratt & Whitney at Cleveland, Wasp engines swept home with both winner and runner-up in the Thompson Trophy Race. Lowell Bayles in his Wasp Junior - powered Gee Bee averaged 236.239 m.p.h.—a second consecutive victory for the Wasp Junior in America's greatest speed classic. Following him closely came J. R. Wedell in a Wedell-Williams —also equipped with a Wasp Junior.

Earlier in the meet Wasp engines took the first six places in the Bendix Cross Country Trophy Race from California, led by Jimmy Doolittle in his Laird "Solution." He averaged over 223 m.p.h. to Cleveland, then continued on to New York and a new West-to-East, Coast-to-Coast record of 11 hrs., 16 min., 10 sec. Likewise, in the Women's Free-For-All Classic, Wasp power captured 1st and 2nd places, Maude-Irving Tait in a Wasp Gee Bee Senior Sport led Mae Haizlip flying a Wasp Junior Laird. These are but a few of the outstanding events of this year's races in which Wasp scored significant triumphs.

Speed—never a sufficient goal in itself—is attained in Pratt & Whitney engines by accumulated refinements in design and construction that likewise increase their reliability and power. The brilliant performances noted above are dramatic verification of the qualities that have made Pratt & Whitney engines the choice of racing, civilian, military pilots and more than 90% of all important transport lines on this continent.

Lowell R. Bayles and the Wasp Junior that helped him capture the Thompson Trophy

★

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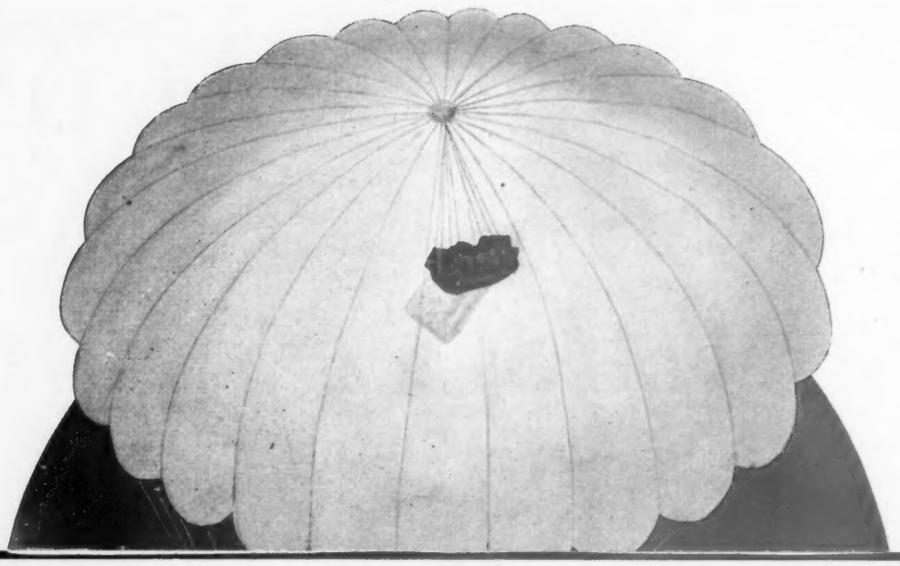
PRATT & WHITNEY AIRCRAFT CO.
EAST HARTFORD . . . CONNECTICUT, U. S. A.
Division of United Aircraft & Transport Corporation

Manufactured in Canada by Canadian Pratt & Whitney Aircraft Co., Ltd., Longueuil, Quebec; in Continental Europe by Bavarian Motor Works, Munich; and in Japan by Nakajima Aircraft Works, Tokyo.

Wasp* & Hornet* *Engines*

* Registered Trade-Mark



A TRIBUTE TO THE NATIONAL AIR RACES

Planes racing at terrific speed—stunts so daring that experienced flyers hold their breath—scores of aircraft representing many nations daily clouding the skies—and not a fatality during the whole meet—a splendid tribute to Aviation and the National Air Races Management. Parachutes played an important part in making this record as four crashes were saved from being tragedies when the pilots jumped and saved their lives by their parachutes.

A high light of the meet was the new altitude record set by Switlik representative, Bert White, in a Switlik Safety Chute—again proving that from high or low altitude, the famous Switlik Safety Chutes give the perfect performance.

Switlik Chutes are sold on an EASY PAYMENT PLAN for your convenience. Write today.

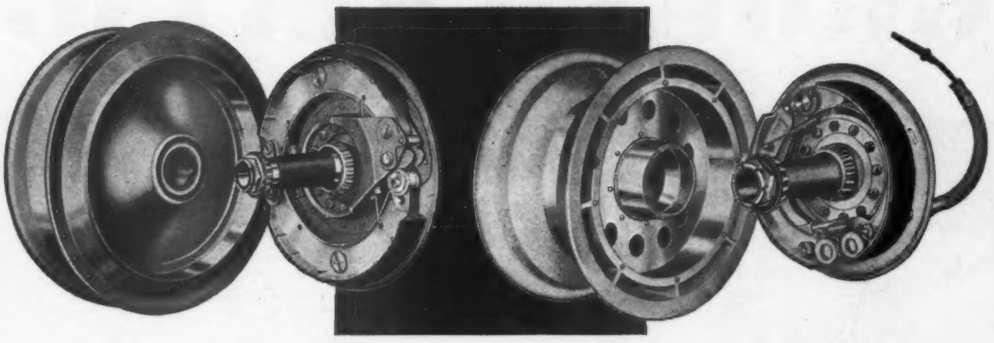
Used by the Navy, Dept. of Commerce Air Mail, and Many Famous Flyers

SWITLIK SAFETY CHUTES

SWITLIK PARACHUTE & EQUIPMENT CO.

TRENTON, NEW JERSEY

WESTERN MANGER — BERT WHITE — 1223 AIRWAY — GRAND CENTRAL AIR TERMINAL — GLENDALE, CALIF.



Look to
BENDIX
for Airplane Wheels and Brakes

Bendix engineering developed and perfected the wheel-and-brake for aircraft—which has contributed so vitally to efficiency in ground maneuvers; and to safety.

Bendix now offers the new roller-bearing wheel and brake for still further increased efficiency.

Bendix also offers the Bendix low-pressure wheel, equipped with roller bearings.

All Bendix' broad experience in brakes—automobile and aviation—is built into these new units.

Built to U. S. Army Air Corps, U. S. Navy, S. A. E., and Tire and Rim Association Standards.

BENDIX BRAKE COMPANY
SOUTH BEND, INDIANA
(Subsidiary of Bendix Aviation Corporation)

BENDIX 4 BRAKES
FOR SAFETY

FULLY PROTECTED BY PATENTS AND APPLICATIONS IN U. S. AND ABROAD

Air Mail Saves Time

Do a little

"GROUND FLYING"

Check up on your oil as carefully as you do your ship and motor

TALK to the pilot who uses Gulfpride Oils and he will tell you that his experience squares with the findings of leading aviation engineers.

Gulfpride Oils show remarkably flat viscosity-temperature curves . . . they hold their body under high operating temperatures, yet they never become stubbornly stiff and tacky at low starting temperatures.

Gulfpride Oils don't foul up the motor with carbon.

Gulfpride Oils give you more power from your motor.

Technical men could tell you that Gulfpride Oils are refined by the Aluminum Chloride process, which employs materials costing $100 per ton instead of the $10 per ton acids commonly used.

That explains why pilots who demand the best in lubricants use Gulfpride Oils.

Facts in FREE BOOK

Over 30,000 copies of the Gulf Aviation Atlas have been distributed. New edition, now ready, brings records and historical maps, charts, etc., up to date. Sent free on request to licensed pilots, licensed mechanics, all those connected with the aviation industry and students in recognized flying schools. Just drop a post card to Lubricating Department, Gulf Refining Company, General Sales Offices, Pittsburgh, Pa., U. S. A.

MORE AIR HOURS

Gulfpride Oil is 100% paraffin base mineral oil refined by the costly Aluminum Chloride method. Exclusive to Gulfpride. Gulfpride Oil exhibits a relatively flat viscosity-temperature curve; high flash and fire values, and low pour tests.

Gulfpride Oil holds its body exceptionally well at high operating temperatures. It is highly resistant to oxidation and emulsifying action.

Gulfpride Oil is made in five viscosities: 75—100—120—150 and 200 at 210° F, providing a superior lubricant for all types of aircraft motors, under all operating conditions.

Ask for Gulfpride Oil and you'll never be grounded because of oil-caused trouble.

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GULF

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POWER

» » ALL WAYS

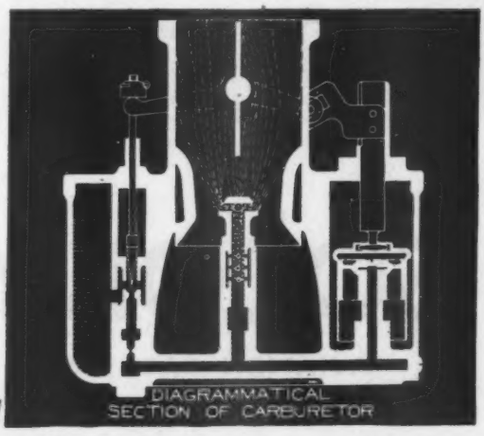
TAKE for instance, upside down flying. Naturally, the same forces that cause the pilot to be supported by his belt, cause the fuel to go to the top of the float chamber of the carburetor.

To prevent excess fuel going to the engine, Stromberg uses a check valve, incorporated in the needle valve seat. Stromberg Aircraft Carburetors function perfectly in the inverted position; the engine continues to run at full throttle. Fuel discharge nozzles, located in line laterally with the center of the float, keep the fuel flow from being disturbed.

When power is demanded from an engine equipped with a Stromberg, it is obtained . . . regardless of the maneuver or position of the plane.

Assurance of *power all ways* is just another Stromberg contribution to the advancement of flying. Stromberg's 22 years experience and research in carburetion is yours to command.

Over 95% of the Aircraft engines being built in the United States today are Stromberg equipped.



DIAGRAMMATICAL SECTION OF CARBURETOR

STROMBERG CARBURETORS

BENDIX STROMBERG CARBURETOR COMPANY

« SUBSIDIARY OF BENDIX AVIATION CORPORATION »

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"HAPPY LANDINGS!"

"Happy Landings!" Of course! But insure "Happy Landings" by fueling your plane with Socony Aviation Gasoline and Socony De-waxed Motor Oil. These products are air-tailored by our own aviation experts—men who test them continually in Socony's own Test Plane under the actual conditions an average pilot encounters. Use this combination every time—Socony Aviation Gasoline and Socony De-waxed Motor Oil—and you'll guarantee yourself "Happy Landings."

SOCONY

AVIATION GASOLINE
DE-WAXED MOTOR OIL

STANDARD OIL COMPANY OF NEW YORK

GENERAL AVIATION CORPORATION
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FOKKER AIRCRAFT CORPORATION OF AMERICA
TO
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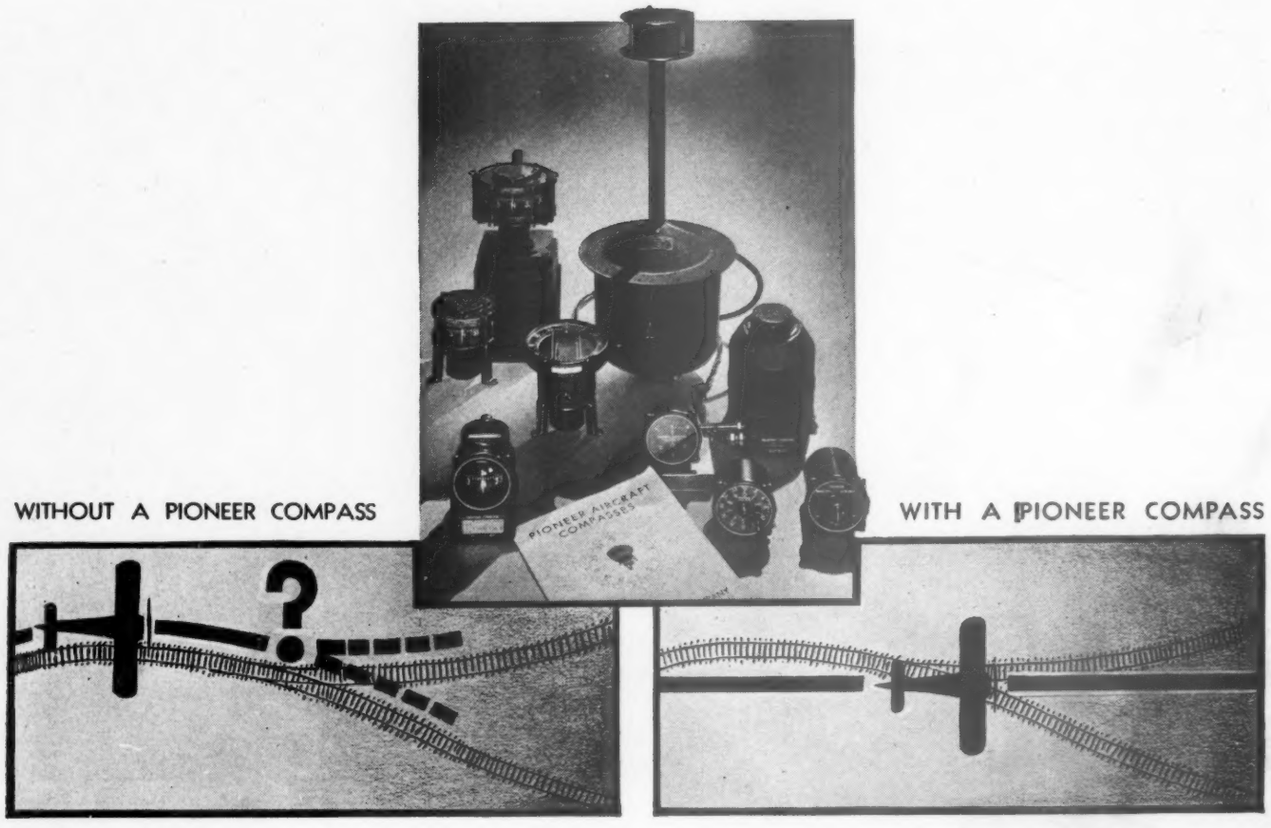
HASBROUCK HEIGHTS NEW JERSEY PLANT TEL. 8-0800	1775 BROADWAY NEW YORK CITY TEL. CIRCLE 7-5720	GLENDALE, WEST VIRGINIA PLANT TEL. WHEELING 4735

COMPASS FLYING

IS FASTER AND SAFER



Compass flying takes you directly to your destination. "Riding the rails" or flying by other landmarks *may* get you there eventually, if you don't take the wrong railroad or if you are not caught out at dusk some evening. Modern pilots are, however, eliminating this guesswork by depending upon Pioneer Compasses.

The angle of drift, a factor in compass flying which has usually been largely a matter of estimation, now can be determined directly and accurately with the new Pioneer Drift Indicator. Any pilot or navigator can quickly and easily gauge his drift. The compass course adjusted with the Drift Indicator will take you directly to your destination.

PIONEER COMPASSES ACCEPTED AS STANDARD

Since 1919 Pioneer Compasses have been the choice of famous pilots and leading transport lines. Today, scores of manufacturers equip their planes with Pioneer Compasses. Their accuracy and reliability assure the pilot that he can depend on them for any kind of duty.

There is a Pioneer Compass for every type of plane. Select the one that fits your needs. We will be pleased to send you a catalogue describing our complete line of Aircraft Compasses.

PIONEER INSTRUMENT COMPANY

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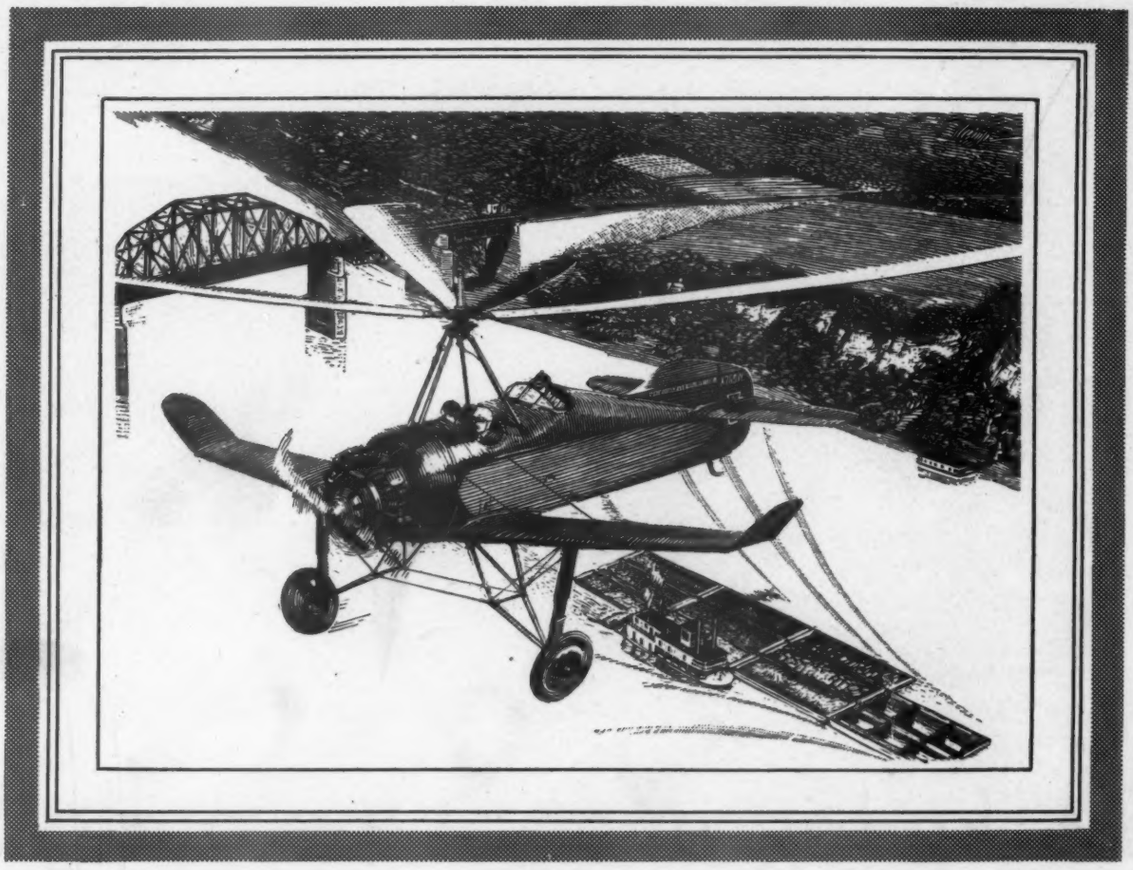

. . . . . For any type of aviation engine

PENNZOIL

costs less per hour

Ask for PENNZOIL—
Not just "Pennsylvania Oil"

Proper lubrication is vital to aviation engines. That's why so many of them are lubricated with Pennzoil Aircraft Oil.

Pennzoil lubricates perfectly under all flying conditions. It reduces repair expense and lengthens the period between overhauls. It lasts twice as long as ordinary oils. It costs less per flying hour. For safety and economy fill with Pennzoil.

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PENNZOIL is made by the famous Pennzoil Process from 100% pure Pennsylvania crude and nothing else.

PERMIT NO. 2—PENNSYLVANIA GRADE CRUDE OIL ASS'N

Stocked in every type and size

to assure immediate delivery

WHEN you need a ball bearing for any plane application, send your order to Fafnir. That's the surest way of getting what you want, and of getting it promptly.

Fafnir makes the most complete line of ball bearings, in America. Comprehensive stocks are carried in important distributing centers throughout the country. 24-hour delivery on standard types is thus assured.

Better bearings than Fafnirs cannot be bought at any price. Precision manufacture, rigid inspection and the use of the finest alloy steel combine to make Fafnir Ball Bearings truly outstanding. Reduction in weight, savings in space and virtual elimination of maintenance have been obtained by Fafnir engineers, with the cooperation of aircraft engineers and designers.

Recommended uses, load ratings, dimensions and other pertinent bearing information is contained in the Fafnir Aircraft Booklet. We would be glad to send you a copy and to cooperate with you in solving your bearing problems.

THE FAFNIR BEARING CO., NEW BRITAIN, CONN.
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Los Angeles Milwaukee Newark New York Philadelphia

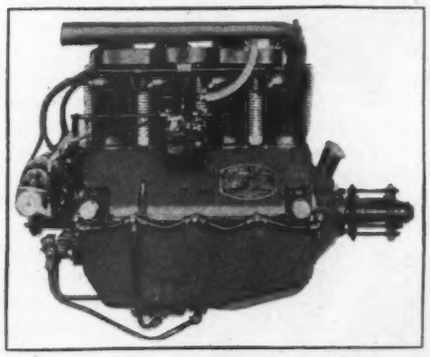
Safeguarding quality

FAFNIR
BALL BEARINGS

Nickel Cast Iron cylinder for Wright Gypsy 4-cylinder engine mfd. by S. CHENEY & SON, Manlius, N. Y.

• • •

Below: *Wright Gypsy vertical 4-cylinder in-line 100 H. P. airplane engine mfd. by WRIGHT AERONAUTICAL CORPORATION, Paterson, New Jersey.*



WRIGHT
KNOWS NICKEL CAST IRON CYLINDERS MEAN BETTER ENGINE PERFORMANCE

When a longer wearing cylinder material was sought for the Gypsy—the latest Wright vertical 4-cylinder in-line engine designed for smaller craft—Nickel Cast Iron was the unanimous choice of Wright engineers.

Nickel Cast Iron, called "the longest wearing cylinder material known today," has unquestionably contributed to the successful performance of the Wright Gypsy. Long hours of flying at high speeds demand a material strong and dense throughout all sections...with high uniform hardness assuring exceptional wear-resistance in cylinder bores. These properties Nickel Cast Iron provides, not only in Wright engines, but in the cylinders of approximately fifteen other leading airplane engines as well.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

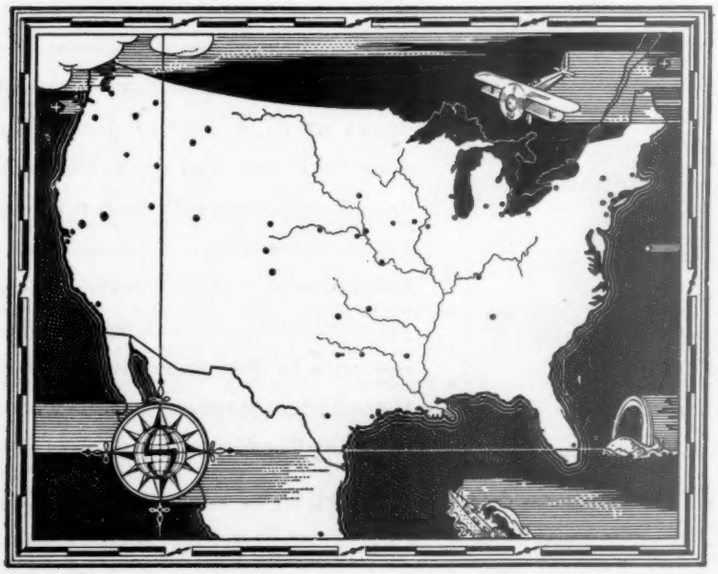
Miners, refiners and rollers of Nickel... Sole producers of Monel Metal

Nickel
CAST
IRON
A BETTER MATERIAL FOR MODERN NEEDS

OUR CASTING SPECIALISTS WILL GLADLY DISCUSS YOUR PROBLEMS WITH YOU

Stearman steps ahead

OBVIOUSLY you want a good ship—a ship that will go places—and quite as obviously you would expect service facilities for that ship wherever you go . . . on-the-spot service at convenient ports—nation-wide . . . where skilled hands . . . men familiar with your ship are at your service. This is vital. This is flying's next step forward . . . Stearman has already taken it. Wise buyers are alert . . . You'll be seeing more Stearmans in the air.



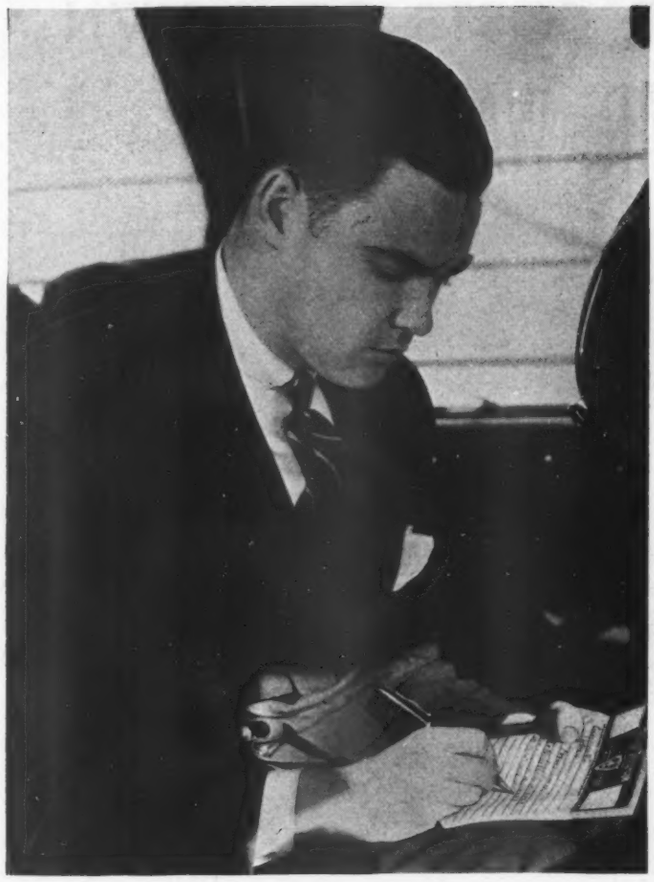
STEARMAN AIRCRAFT COMPANY, WICHITA, KANSAS, Division of United Aircraft and Transport Corp.

For every flying reason

STEARMAN

Junior Speedmail 300 and 400 H. P.
. . . . . Business Speedster 240 H. P.
. . . . . Cloudboy 165 H. P.

. . . . . the Stearman ship itself
. . . . . the Stearman organization
. . . . . backed by the United Group
. . . . . the new factory, hub of nation-wide service facilities



EN ROUTE

...AND IN TOUCH WITH THE WORLD

...THE PLANE IS A POSTAL TELEGRAPH OFFICE

● Like all other travelers, air travelers have messages to send *en route.* A reservation...an appointment...whatever the message is, they expect the same facilities for sending it from a plane as they do from a train or a ship. And why shouldn't they have this service, especially when it means no expense to the transport company?

All you need do to link your planes in a world-wide system of communication facilities is to provide Postal Telegraph blanks in each plane and instruct your attendants to file messages at scheduled stops.

The passenger writes the message at his leisure. The attendant files it at the next scheduled stop. Postal Telegraph does the rest. Simple, isn't it? And it's a convenient, extra service that passengers appreciate... a service that makes air travel more agreeable.

Postal Telegraph complements air travel with fast, dependably accurate communication service to 70,000 points in the United States, 8,000 in Canada... and to the entire world through the great International System of which Postal Telegraph is a part.

Wire Postal Telegraph Headquarters in New York for full details of this new service. *Postal Telegraph is the only American telegraph company that offers a world-wide service of co-ordinated record communications under a single management. Through the great International System of which Postal Telegraph is a part, it reaches Europe, Asia, The Orient over Commercial Cables, Central America, South America and the West Indies over All America Cables, and ships at sea via Mackay Radio.*

● *Think this over carefully. Why should the plane, of all the organized means of transportation available to the traveler, fail to provide communication facilities?*

THE INTERNATIONAL SYSTEM

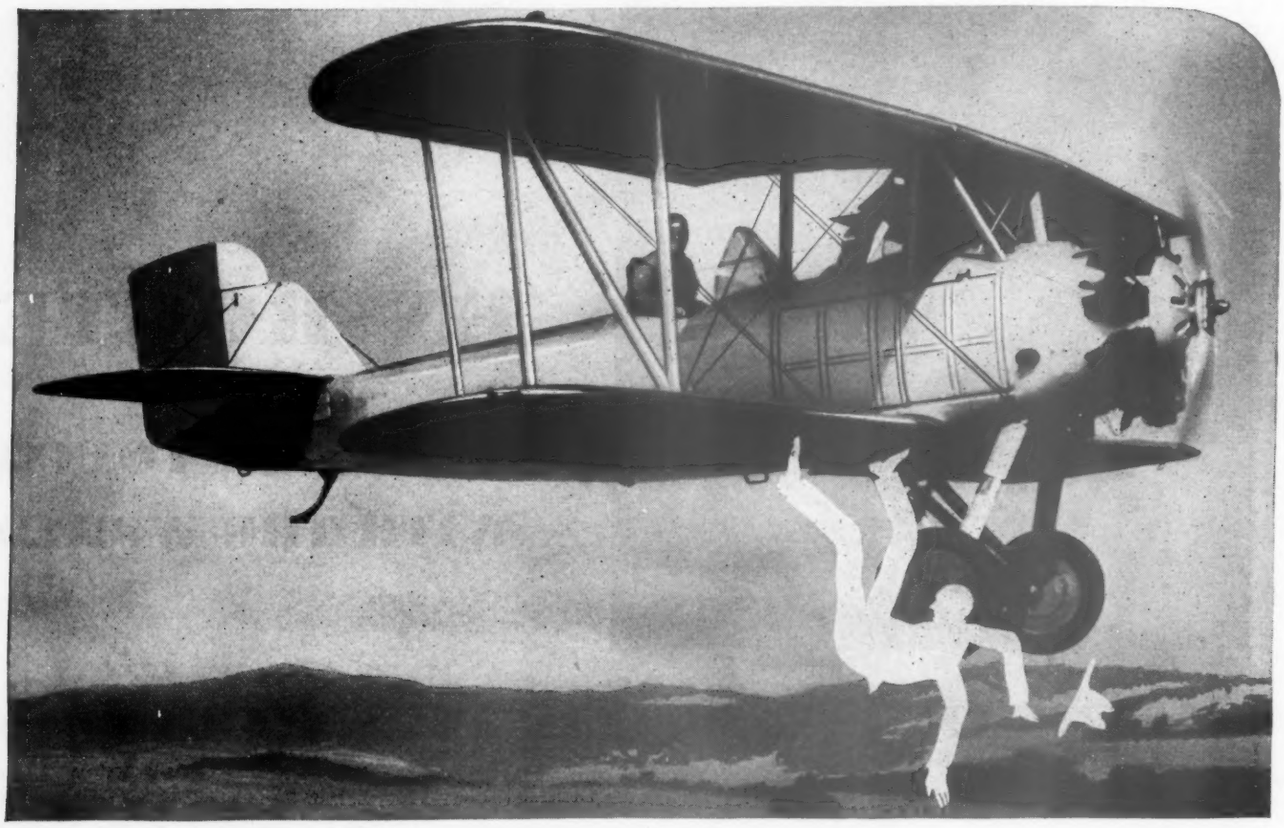
Postal Telegraph

Commercial Cables — *All America Cables*

Mackay Radio

WHEN YOU GO OUT, COSTS GO DOWN

SO OUT YOU GO, MR. WATER-THIN!



MR. WATER-THIN is a loafer. A waster. A spendthrift of your money. For he's the quart or more of thin, waste oil that ordinary refining leaves in every gallon of aero oil. Non-lubricating stuff that vaporizes quickly under engine heat.

But there's none of this waste in Quaker State Aero Oil. Quaker State refining—*the most modern in the industry*—removes it. Removes it and replaces it with rich, full-bodied lubricant. Quaker State gives you four quarts of good oil to the gallon—not three quarts and one of waste. So you really get an extra quart. You get an oil so good that the demand for it has made Quaker State the *world's largest selling Pennsylvania Oil!*

Every drop of Quaker State Aero Oil is made entirely from 100% pure Pennsylvania Grade Crude Oil. Quaker State is so free from impurities that it doesn't require acid treatment in refining. That's important! For acids tend to destroy some of an oil's oiliness.

Test out Quaker State Aero Oil in your planes. You will find that it stays *good* lubrication long after ordinary oil would be reduced to useless waste. You will find that it saves money in oil costs and in maintenance costs. You will discover mighty soon that Quaker State's extra quart of lubrication makes it the finest oil, the most economical oil that ever went aloft!

QUAKER STATE

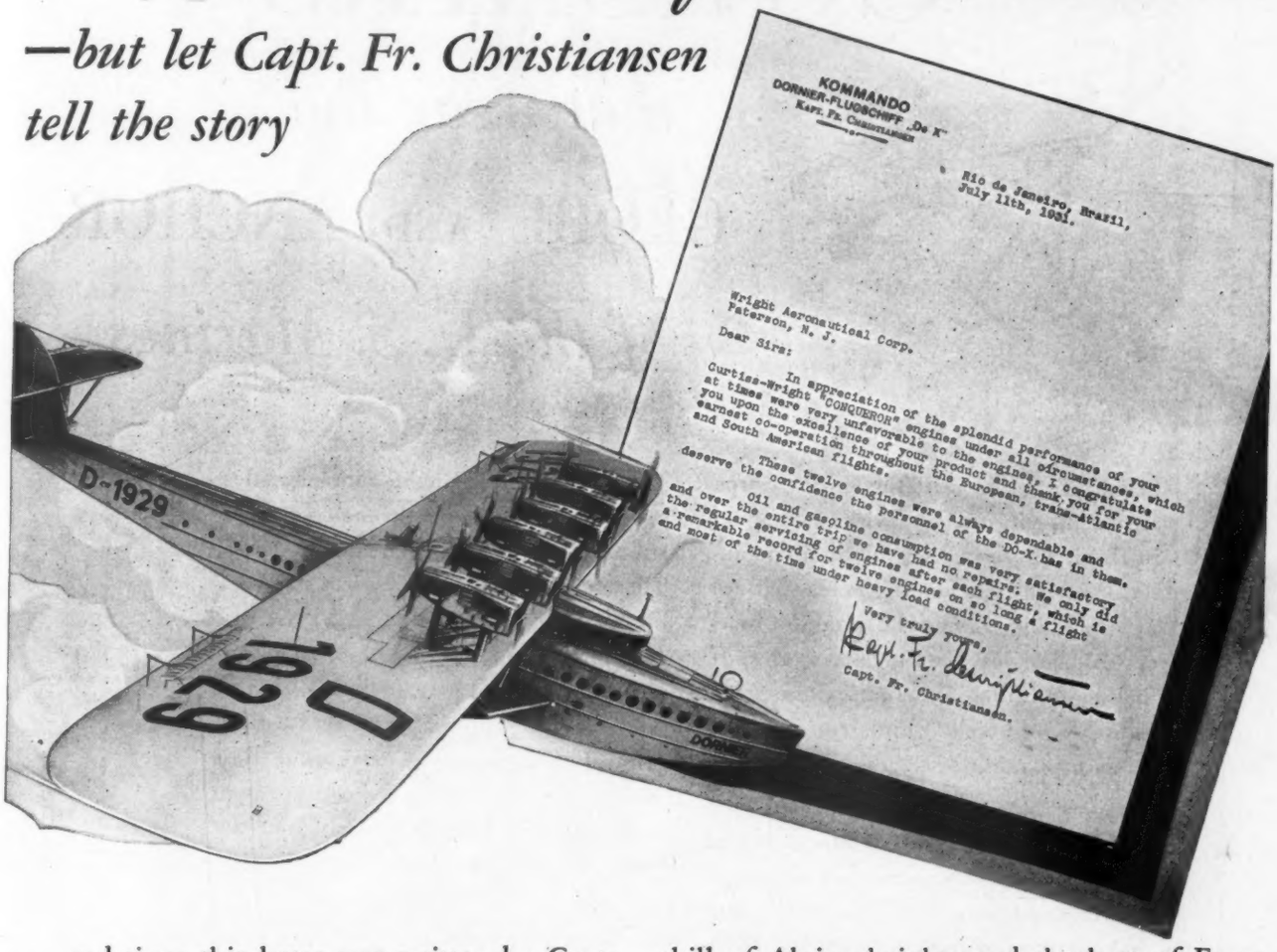
TRADE-MARKS REG. U.S. PAT. OFF.

MOTOR OIL

THERE'S AN
EXTRA QUART
OF LUBRICATION
IN EVERY GALLON

They put *Curtiss Conquerors* in the DO-X

—but let Capt. Fr. Christiansen tell the story


KOMMANDO
DORNIER-FLUGSCHIFF „Do X"
KAPT. FR. CHRISTIANSEN
Rio de Janeiro, Brazil,
July 11th, 1931.
Wright Aeronautical Corp.
Paterson, N. J.
Dear Sirs:
In appreciation of the splendid performance of your Curtiss-Wright "CONQUEROR" engines under all circumstances, which at times were very unfavorable to the engines, I congratulate you upon the excellence of your product and thank you for your earnest co-operation throughout the European, trans-Atlantic and South American flights.
These twelve engines were always dependable and deserve the confidance the personnel of the DO-X has in them.
Oil and gasoline consumption was very satisfactory and over the entire trip we have had no repairs. We only did the regular servicing of engines after each flight, which is a remarkable record for twelve engines on so long a flight and most of the time under heavy load conditions.
Very truly yours,
Capt. Fr. Christiansen.
D-1929
DORNIER

. . . and since this letter was written by Capt. Christiansen the DO-X on its trade missionary trip has flown from Brazil, touched at Cuba and along the Eastern Coast of the United States and successfully landed at New York City. ◐ The world-traveling DO-X adds fame to the Dornier staff that designed and built it. Every one of the thousands of miles it has flown adds to the Curtiss-Wright reputation for building Aviation's most reliable power. When the extensive world trip was planned through the chill of Alpine heights and the heat of Equatorial sun, with true German thoroughness the most reliable power was sought. From the world market, 12 Curtiss-Wright "Conquerors," of 600 h. p. each, were chosen. ◐ Colonel Lindbergh, as a result of his experience with the reliability of Wright Engines, selected a Wright for his flight to Japan. It is this same reliability that has enabled *Wright-Powered Planes to win the National Reliability Tour six consecutive years.*

WRIGHT
AERONAUTICAL CORPORATION
PATERSON NEW JERSEY
A DIVISION OF CURTISS-WRIGHT CORPORATION

CORSAIRS

that wear the GLOBE AND ANCHOR *of the U. S. Marines*

Corsairs **in service with the Marine Corps are usually in *active* service. It may be in Haiti, whose ragged, mountainous interior affords few landing fields that are even possible. It may be over the inaccessible jungles of Central America. It may be in China in sections where plane failure would write "Finis" to an aerial mission.**

Corsairs **ask no odds of the men who make their assignments, or the men who do the flying. The stamina to stand rough landings and the performance to get into and out of small fields are traditional with this plane. So, too, are its speed—its climb and its excellent handling qualities.**

These distinctly Vought characteristics have carried *Corsairs* through years of strenuous service with the Marine Corps. They have made the *Corsair* a standard observation plane with the Navy. And they make it an ideal ship for fast executive transport and private flying. Chance Vought Corporation, Division of United Aircraft & Transport Corporation, East Hartford, Connecticut. Export representative: United Aircraft Exports, Inc., 230 Park Avenue, New York, N. Y.

CHANCE VOUGHT CORPORATION

No. 12 of a series of advertisements on "How Superlative Quality is Built into Roebling Wire Rope"

World's largest rope-making machine

"World's Largest" does not begin to reveal the capability or tremendous capacity of this giant —a Roebling machine that takes huge strands of steel wire and "lays" them into finished rope.

In rope diameter, the capacity of this machine is practically unlimited. It can make ropes of a diameter far beyond commercial use. In fact, about its only limitation is a capacity to turn out a maximum of 80 tons in weight of rope *in a single length* without reloading. And such a load exceeds the normal capacity of carriers.

This "closing machine", one of many of various types used by Roebling, is an excellent example of Roebling's unsurpassed rope making facilities. With such a machine, rope of the largest diameters can be handled without the slightest danger of over-stressing. The result is — higher rope efficiency, higher all-around quality.

Incidentally, all the large suspender ropes for the famous George Washington Memorial Bridge, spanning the Hudson River, were made in the machine shown.

JOHN A. ROEBLING'S SONS CO., TRENTON, N.J.
Branches in Principal Cities *Export Dept.: New York*
WIRE · WELDING WIRE · FLAT WIRE · COPPER AND INSULATED WIRES AND CABLES · WIRE CLOTH AND WIRE NETTING

ROEBLING WIRE AIRCRAFT PRODUCTS

What is "OCTANE NUMBER"?

What does it mean to pilots and to men who buy gasoline?

•

Engine reliability is essential to safety in the air. Engineers everywhere agree that no single factor has so vital an effect on engine performance as the "knock-rating" (or anti-knock value) of the fuel used. Knocking or detonation will ruin the finest of engines.

All crude petroleums and all gasolines made from them consist chiefly of hydrocarbons, chemical combinations of hydrogen and carbon. One of these, iso-octane, has an exceptionally good knock-rating; another, normal heptane, exhibits the opposite characteristic. By mixing the two in various proportions, a fuel of any desired intermediate knock-rating may be obtained.

The octane number is the generally accepted method of expressing the knock-rating of a gasoline. It simply means the percentage of octane in the octane-heptane mixture which has the same knock-rating as the gasoline. As iso-octane is the knock-suppressor in the mixture, the higher the octane number of a gasoline the better its knock-rating, or anti-knock value.

To the pilot or the purchasing agent buying aviation gasoline, the octane number furnishes a definite measure of the most essential characteristic. A gasoline having a minimum octane number of 73* will allow full throttle operation without destructive detonation in the very great majority of present-day, air-cooled aviation engines. Stanavo distributors or the manufacturer of your engine will gladly advise you regarding the fuel requirements of your engine.

**This value is based on tests using the series 30 Ethyl Gasoline Corporation single cylinder test engine at 600 r.p.m. 300° F. jacket temperature and 15° spark advance.*

STANAVO
AVIATION GASOLINE AND ENGINE OIL

STANAVO SPECIFICATION BOARD, Inc.
Organized and Maintained by

Standard Oil Company of California
225 Bush St., San Francisco

Standard Oil Company (Indiana)
910 So. Michigan Ave., Chicago

Standard Oil Company of New Jersey
26 Broadway, New York City

The

PILGRIM

100-A

Transport Airplane

Developed to suit today's transportation needs — not designer's prejudice.

In every kind of transportation!

Passengers demand COMFORT

They choose their travel service on that basis. A study of comments from more than 100,000 air travelers has helped build this "passenger's" airplane. That's why it has ample leg room • wide easy seats • individual ventilation control • individual heating control • fullview windows • quietness • ample head room • toilet facilities • no bother from baggage and mail loading • reasonable speed.

Operators demand PROFIT

They choose equipment on that basis. Study of more than 20 million miles of country-wide airline operations has helped build this "operator's" airplane. That's why it carries 9 passengers • their baggage • 223 pounds of mail • (space for 423 pounds) • two-way radio telephone and radio beacon equipment • night flying equipment • all proven navigation aids • fuel for over 400 miles • at a speed of 2 miles per minute.

The ability to provide swift, comfortable, restful travel, and the features necessary for minimum cost and an operating profit, are combined in the design of the

PILGRIM 100-A

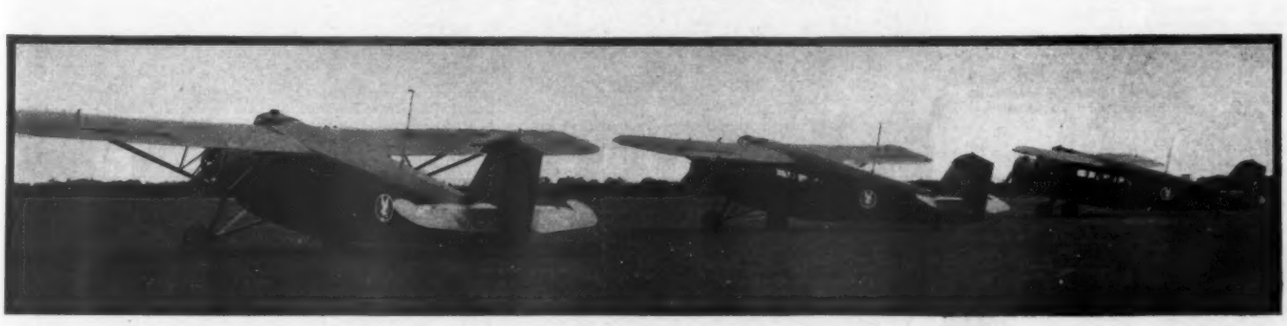
Transport Airplane

AMERICAN AIRPLANE & ENGINE CORPORATION

Manufacturing Division of The Aviation Corporation.

Farmingdale, Long Island, New York

Manufacturers of PILGRIM Airplanes and RANGER Engines

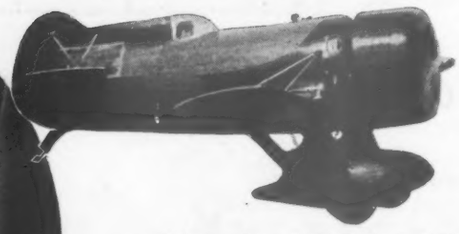


First three of a fleet of 10 PILGRIM 100-A Airplanes, ready to leave Farmingdale for delivery to American Airways

. . . KENDALL RIDES

. . . In the Transcontinental the 1931 National Air Races, by Pilots Winning Over 86%

Phoebe Omlie, Women's Transcontinental Handicap Derby winner.



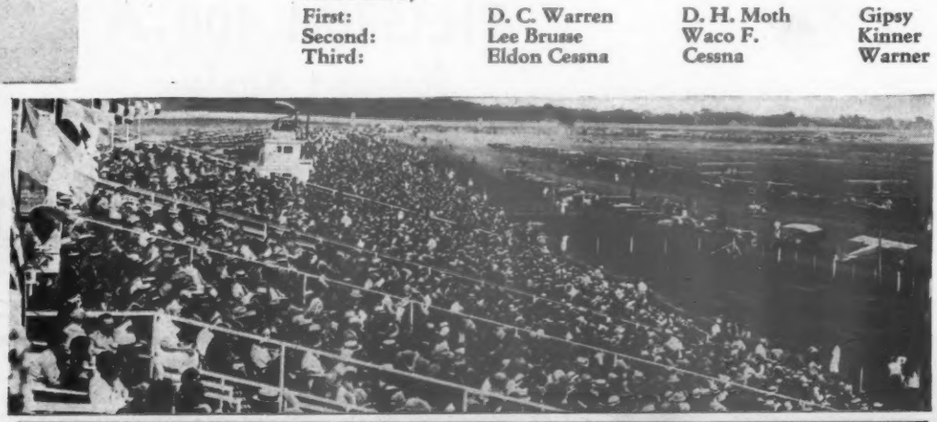
Never before in Aviation history has any product achieved such overwhelming approval as the free and open choice of Kendall Oil by pilots, both men and women, who participated in the National Air Races of 1931. Never before has the outstanding worth of a lubricating oil been so thoroughly demonstrated as by the splendid victories in which Kendall had a part. These facts of Kendall performance in the races concern every manufacturer, owner or pilot of every airplane.

Transcontinental Handicap Derbies

For the severe test of speed and endurance demanded in the California to Cleveland Derbies for men and for women pilots, Kendall was the lubricant used in 60 of the 61 competing planes. The results were all Kendall:

Women's Derby	*Pilot*	*Plane*	*Engine*
First:	Phoebe Omlie	Monocoupe	Warner
Second:	May Haizlip	Monocoupe	Lambert
Third:	Martie Bowman	Inland Sport	Warner
Men's Derby			
First:	D. C. Warren	D. H. Moth	Gipsy
Second:	Lee Brusse	Waco F.	Kinner
Third:	Eldon Cessna	Cessna	Warner

D. C. Warren, first prize winner of the Men's Handicap Derby.



America's Finest Air Race at Cleveland played to a vast and enthusiastic audience.

KENDALL

WITH THE WINNERS

Derbies and the Closed Course Events of Kendall Oil was the Lubrication Used of All First, Second and Third Places . . .

Free-for-all Speed Classics

In the Thompson Trophy Race for men and the Cleveland Pneumatic Aerol Trophy Race for women, Kendall Oil was with the winners from start to finish:

Thompson Trophy	*Pilot*	*Plane*	*Engine*
First:	Lowell Bayles	Gee Bee	Wasp
Second:	J. R. Wedell	Wedell-Williams	Wasp
Third:	"Red" Jackson	Laird "Solution"	Wright

Cleveland Pneumatic Aerol Trophy

First:	Maude Tait	Gee Bee "Y"	Wasp
Second:	May Haizlip	Laird	Wasp Jr.
Third:	Florence Klingensmith	Cessna	Kinner

Kendall—All the Way

The early records show that in all the events, including the Derbies, there were 311 entries and of these 278 planes were lubricated with Kendall Oil. Out of a possible 31 each of first, second and third places in the races, Kendall Oil was used by 27 First Place Winners, 26 Second Place Winners and 27 Third Place Winners—representing in all 86.02% of the prize winners for all events.

Watch for Kendall advertisements giving further remarkable highlights of the 1931 Races. Join America's famous pilots in choosing Kendall Oil as favorite lubrication for your plane. Kendall, carefully refined from the world's finest and costliest crude—the Bradford Grade of Pennsylvania—will give a full thirty hours of real service in your plane, merely by maintaining the oil level. Write for information on Kendall Oil and a list of Airports where it may be obtained. Kendall Refining Company, Bradford, Pennsylvania.

Maude Tait captured the free-for-all speed classic for women.

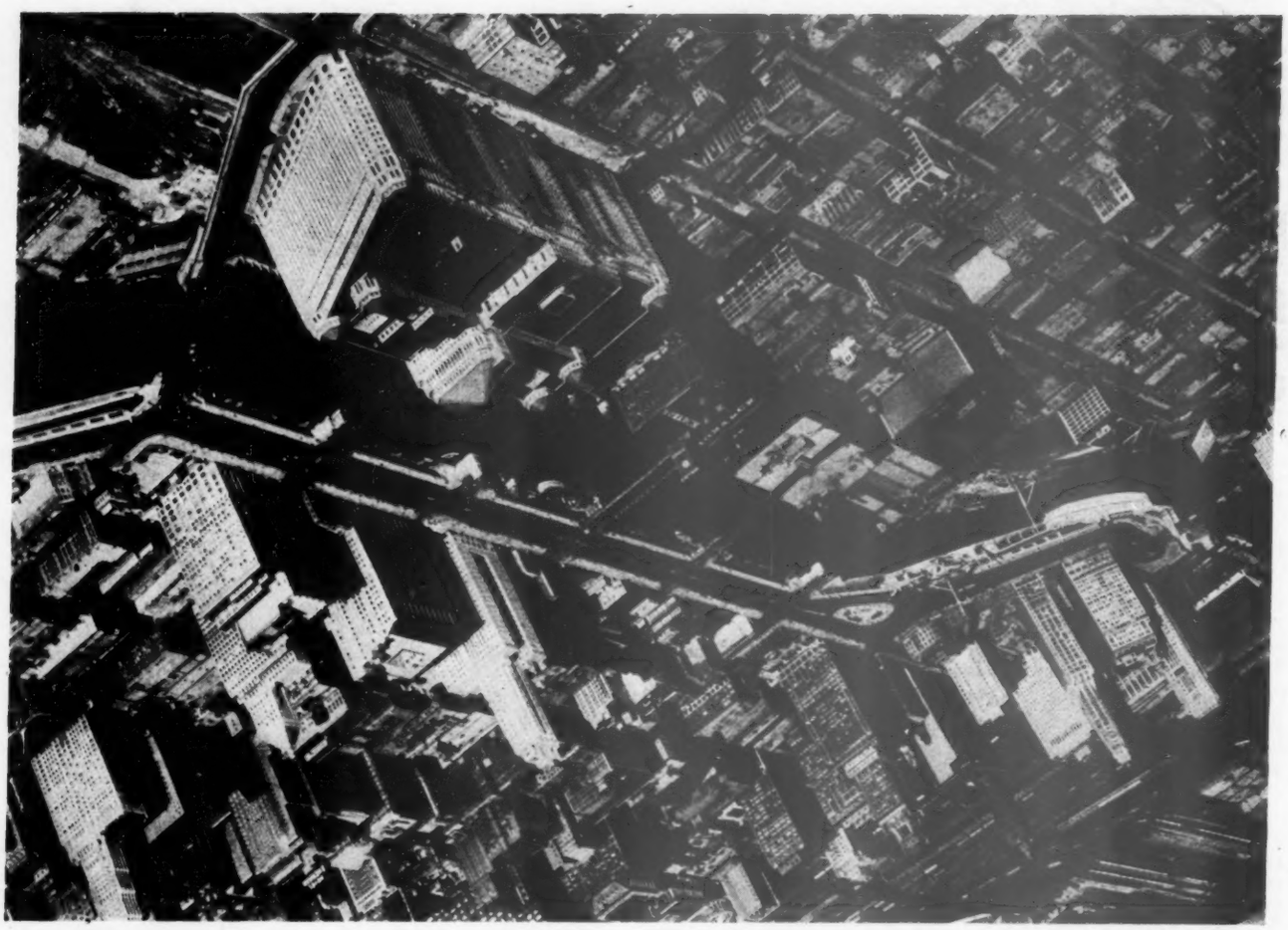
Lowell Bayles won first prize in the Thompson Trophy Race with a speed of 236.239 m.p.h. His qualifying speed averaged 267.342 m.p.h., greatest recorded speed for this event.

60 of these 61 well-known planes in the Transcontinental Derby were Kendall-lubricated.

OIL REFINED FROM 100% BRADFORD GRADE OF PENNSYLVANIA CRUDE

BUY AT THIS SIGN
PENZBEST
KENDALL
MOTOR OILS

THE ELECTROLYTE WILL NOT SPILL



You may look at Chicago like this and yet be battery-safe, when there's an Exide in your cockpit.

This Exide Aircraft Battery was made to fly. It's light-weight, compact, safe.

Contractors
to the U. S. Army & Navy

Exide Aircraft Batteries are so designed that even loops will not spill the electrolyte

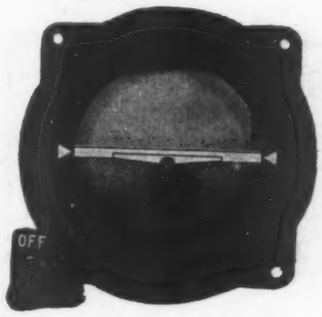
THE Exide Battery is as dependable as it is safe. It helps make radio communication certain in fog and storm. It furnishes reliable current for landing, navigation and instrument lights—starting and ignition.

Exides have already proved their worth over millions of miles of sky lanes. Just ask your flying friends about Exide reliability . . . its compactness . . . its light weight.

Write today for further information about the many types of Exide Aircraft Batteries. One-seater "mono" or transcontinental air liner—there's an Exide to fill the bill.

Exide
AIRCRAFT BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE
Exide Batteries of Canada, Limited, Toronto



the SPERRY HORIZON . . . .

SINCE the natural horizon is the reference which a pilot is instinctively trained to use, the Sperry Horizon has been designed to replace the natural horizon; thus giving an attitude indicator which has no time lag; which does not require interpretation; and which provides a guide that the pilot can instinctively and naturally depend on without "concentration fatigue."

THE TEXAS COMPANY
135 EAST 42ND STREET
NEW YORK

FRANK M. HAWKS
AERONAUTICAL ADVISOR

SPERRY GYROSCOPE CO.
RECEIVED
AUG 19 1931
REFERRED TO | Approved
ANS.

August 18, 1931

Sperry Gyroscope Company, Inc.
Manhattan Bridge Plaza,
Brooklyn, New York.

Gentlemen:

Now that the Sperry Gyro Horizon has been installed in my ship "Texaco #13" and I have given it a thorough test in blind flying, I want to say with all sincerity that I feel safer than I have ever felt before when flying in thick weather.

On my recent trip to Chicago the take-off from New York was effected in rather heavy rain with a low ceiling and poor visibility. After a short ten minute test to ascertain that the instrument was functioning, I pulled up into the fog and remained in it for one hour. The instrument functioned perfectly and I was able, at all times, to know my position accurately. You will appreciate that this is somewhat of a test because of the sensitiveness of the plane I fly and by virtue of its high speed it has a very rapid climb and descent in ratio to the angle of either. The Sperry Gyro Horizon registers these manouvers very quickly and accurately.

The development of this instrument deserves great praise and please accept my humble congratulations upon the success you have attained with it to date.

Yours very truly,

Frank Hawks

FMH:DE

Safer FLYING

CAPTAIN FRANK HAWKS, like many other seasoned pilots, recognizes the fact that every precaution must be taken to make and keep flying safe. That is why he uses the Sperry Gyro-Horizon in his high speed sensitive plane.

Over four hundred Horizons are now in use on planes of all types from training ships to the largest passenger carriers.

Complete data sent on request.

the SPERRY DIRECTIONAL GYRO

THE Sperry Directional Gyro is an airplane navigating instrument for indicating to the pilot the compass course of his plane. It has no meridian seeking properties and therefore must be occasionally checked and re-set in accordance with the heading as given by the magnetic compass. Unlike the magnetic compass it does not oscillate on turns or in rough air. It can also be used as an extremely accurate index of turn for flight purposes.

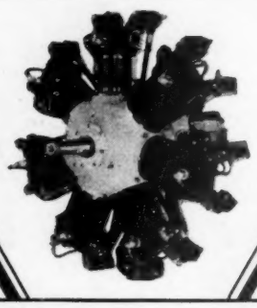
A DIVISION OF SOUTH AMERICAN AVIATION INC.

SPERRY GYROSCOPE CO., *Inc.*

BROOKLYN — NEW YORK

★

Helping Warner to win



A reliable product

BACK of the laurels won by Warner "Scarab" engines at the 1931 National Air Races is the master craftsmanship of the Govro-Nelson shops—where many of the parts used in these engines were machined with faithful accuracy, in a plant where the latest and most modern equipment is combined with aviation skill and experience that dates back to the beginning of the industry.

Information or quotations will be sent promptly upon receipt of your blue prints.

THE GOVRO-NELSON COMPANY

1931 ANTOINETTE DETROIT

CRAFTSMEN TO THE AVIATION INDUSTRY

Do you know that . . .

each month our subscription department receives more than 150 requests for "Back" issues of AVIATION?

♦ ♦ ♦

If we printed extra copies of our monthly issues, we would be glad to comply with these requests, but unfortunately we have no way of knowing in advance just how many of our newsstand readers will "miss" an issue.

♦ ♦ ♦

***But We Do Know*—that each of these requests indicates a reader has "missed" just the issue he could make valued use of.**

Insure your receiving* AVIATION *regularly by filling in the coupon below, today

AVIATION
10th Ave. at 36th Street, N. Y. C.

Here is my check for $3.00. Send me Aviation for one full year.

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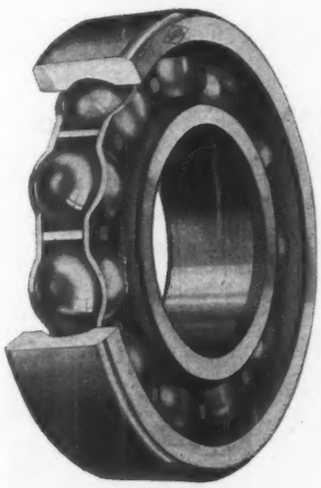
Subscription Rates: U. S., Canada and Mexico, $3; Central and South America, $6; all others, $8.

SRB
ROCKER ARM BEARINGS
Full type ball construction without cages. One side shielded.

19 *Aircraft Engine Manufacturers Use* SRB AVIATION BALL BEARINGS As Original Equipment



SRB
MAXIMUM CAPACITY SINGLE-ROW
Has greatest radial capacity which can be incorporated into a single-row bearing of well balanced design.

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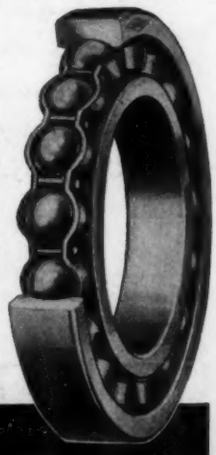
BACK in the pioneer-days of the Aviation industry the motors of Wright, Curtiss, Warner, Pratt & Whitney trusted important bearing positions to SRB Ball Bearings . . they still do! What could be more convincing of a product's merit than the continued patronage of these precision engine builders with international reputations for super-critical performance standards.

Today, nineteen American engine manufacturers use SRB Aviation Ball Bearings . . multiple proof that SRB's serve with confidence in installations where there can be no compromise with quality.

Allison Engineering Co.
American Airplane & Engine Corp.
Cameron
Continental Aircraft Engine Co.
Curtiss
General Airmotors Corp.
Hallet Mfg. Co.
Hudson Industries
Hurricane Aviation Corp.
Irwin Aircraft Co.
Jacobs Aircraft Engine Co.
Kimball Aircraft Corp.
Lambert Aircraft Engine Corp.
LeBlond Aircraft Engine Corp.
Lycoming Mfg. Co.
MacClatchie Mfg. Co.
Pratt & Whitney Aircraft Co.
Warner Aircraft Corp.
Wright Aeronautical Corp.

•

SRB
TYPE "V" AVIATION BALL BEARING
Exceptionally high capacity—saving 13.8% to 26.6% in weight.

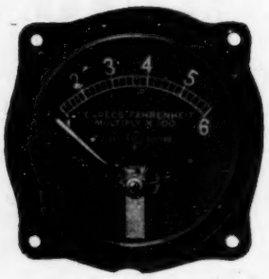


STANDARD STEEL AND BEARINGS INCORPORATED
DIVISION OF MARLIN-ROCKWELL CORPORATION
Plainville *Connecticut*

Ball SRB Bearings

ELECTRIC INSTRUMENTS
COST LESS TO MAINTAIN

WHEN you compare instrument costs, be sure to consider maintenance. Remember that electric instruments require no tubing or shafting. They cost less to maintain.



Electric engine-temperature indicator (thermocouple type)

Electric tachometer

Electric pressure indicator (fuel or oil)

Electric temperature indicator for oil

General Electric also manufactures high-quality navigation instruments such as magneto and card compasses. Let us send you complete information. General Electric Company, Schenectady, N. Y.

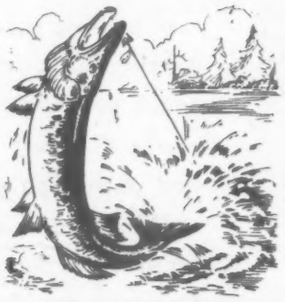
GENERAL ELECTRIC

700-13

AËRONAUTIC EQUIPMENT

PAGE FENCE
in 4 Metals

"MUSKIES" can't live in the ocean!



● This leaping, slashing, lunging fresh water "battler" quickly withers and dies when placed in the ocean. Its fins and gills will not withstand the ravishment of salt water. The same thing is true in fencing.

A good fence for one locality may be foolish extravagance in another because of the changed corrosive conditions is has to meet. That's why PAGE FENCE is made in four different metals—each the best to overcome certain atmospheric conditions—each the best to assure years and years of satisfactory service.

1. PAGE *"ALCOA"* ALUMINUM
2. PAGE ARMCO INGOT IRON
3. PAGE COPPER-BEARING STEEL
4. PAGE ORNAMENTAL WROUGHT IRON

● Before fencing your grounds, call in a PAGE FENCE expert. He will tell you which PAGE FENCE will give the longest service in your locality. He will offer worthwhile suggestions from plans to erection. Write today for his name and address and for a copy of our new booklet "Border Patrol" which contains complete information and shows various styles. No obligation. Address Page Fence Association, 520 N. Michigan Avenue, Dept. E74, Chicago, Ill.

America's first wire fence since 1883

PAGE

nation-wide service through 64 service plants

FENCE

Fence of Armco Ingot Iron fabric is exclusive with Page

Page Fence is a Product of The Page Steel & Wire Co., an Associate Company of American Chain Co., Inc.

CHAIN LINK OR ORNAMENTAL WROUGHT IRON

91% of the engines participating in the 1931 National Air Races were B. G. equipped.

The planes finishing first, second and third in the Thompson Trophy, Bendix Trophy and Derby Races were B. G. equipped.

Of the 634 aircraft engines on the field during the period of the races, 83% were B. G. equipped.

THE B. G. CORPORATION

Contractors to the United States Army and Navy

136 WEST 52nd STREET, NEW YORK **Cable Address: Golsteco, New York**

Welding eight steel tubes to one point. Photograph by courtesy of the Stinson Aircraft Corporation and World's Work.

A CHAIN IS AS STRONG . .

A CHAIN is as strong as its weakest link goes an old saying. In airplane building, as in chain forging, high quality materials are of paramount importance.

We are called upon by leading airplane manufacturers, to supply all or part of their seamless steel tubing requirements. That this confidence is not misplaced is evidenced by the fact that The Ohio Seamless Tube Company long has been producer of the largest variety of seamless steel tubing known to industry.

Due to SHELBY expert workmanship, we can meet your needs in tubing, made from any steel . . . plain carbon, Toncan, Nitralloy or special alloys . . . that meet the stringent government specifications.

Consult our steel tubing specialists. They will be glad to help you solve any steel tubing problem you may have.

The OHIO SEAMLESS TUBE CO.

COLD DRAWN SEAMLESS STEEL TUBING

Shelby, OHIO

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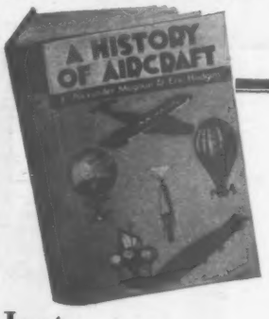
MICHIGAN OFFICE:
2857 East Grand Boulevard,
Corner Oakland, Detroit, Michigan

SOUTHWESTERN OFFICE: 2646-48 Washington Boulevard, St. Louis, Mo.

How old is aviation?



Just Published

This new book traces its history back to its beginning. In fascinating, readable, yet scientifically accurate manner this book tells the story of man's efforts to fly, from the first crude theorizing of early times down to the record-breaking achievements of today.

A History of Aircraft

by F. ALEXANDER MAGOUN *and* ERIC HODGINS

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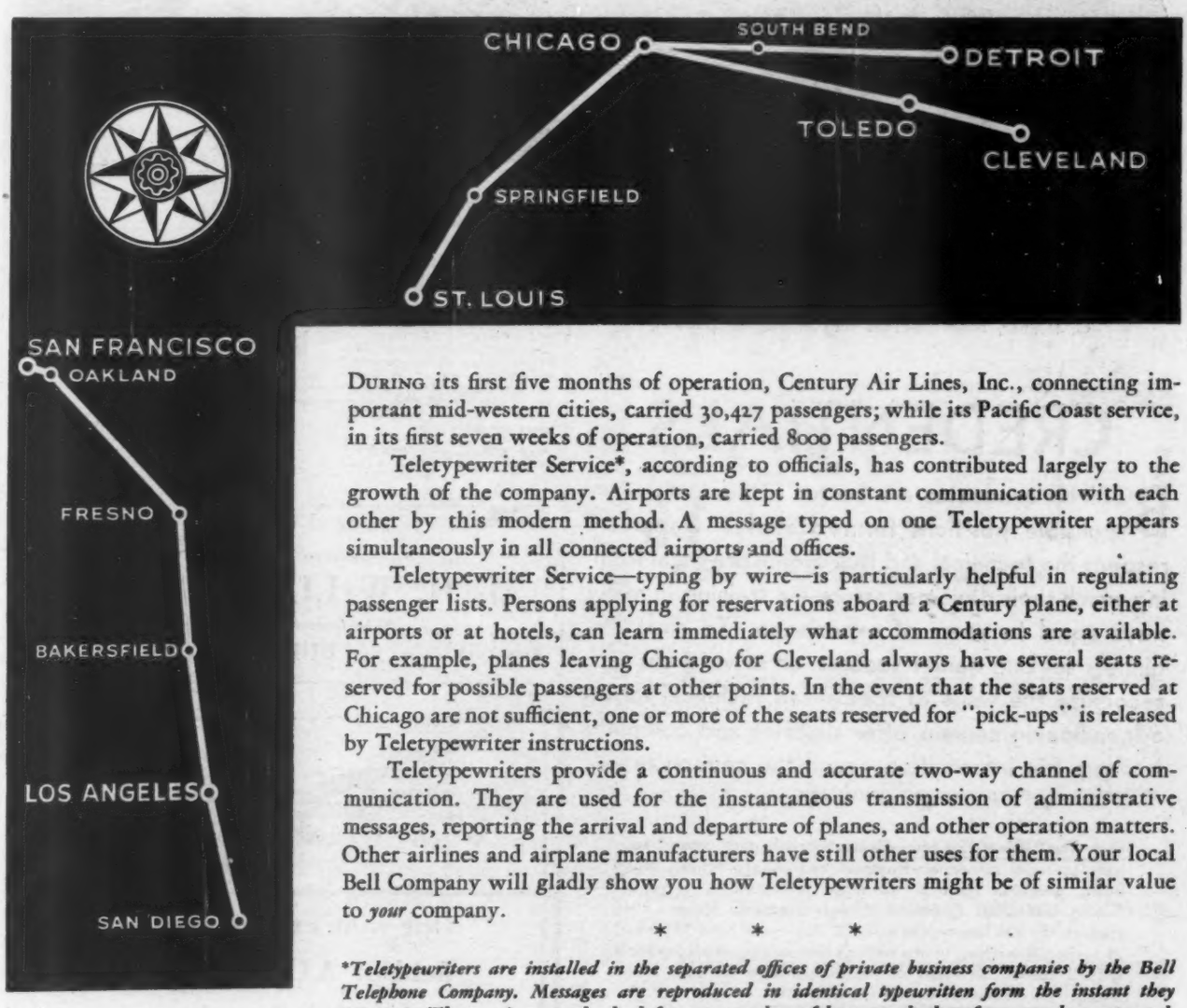

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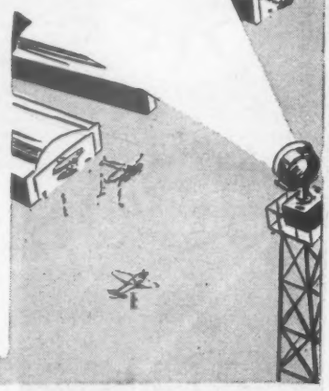

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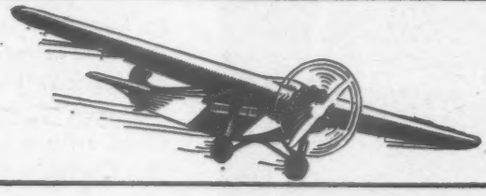

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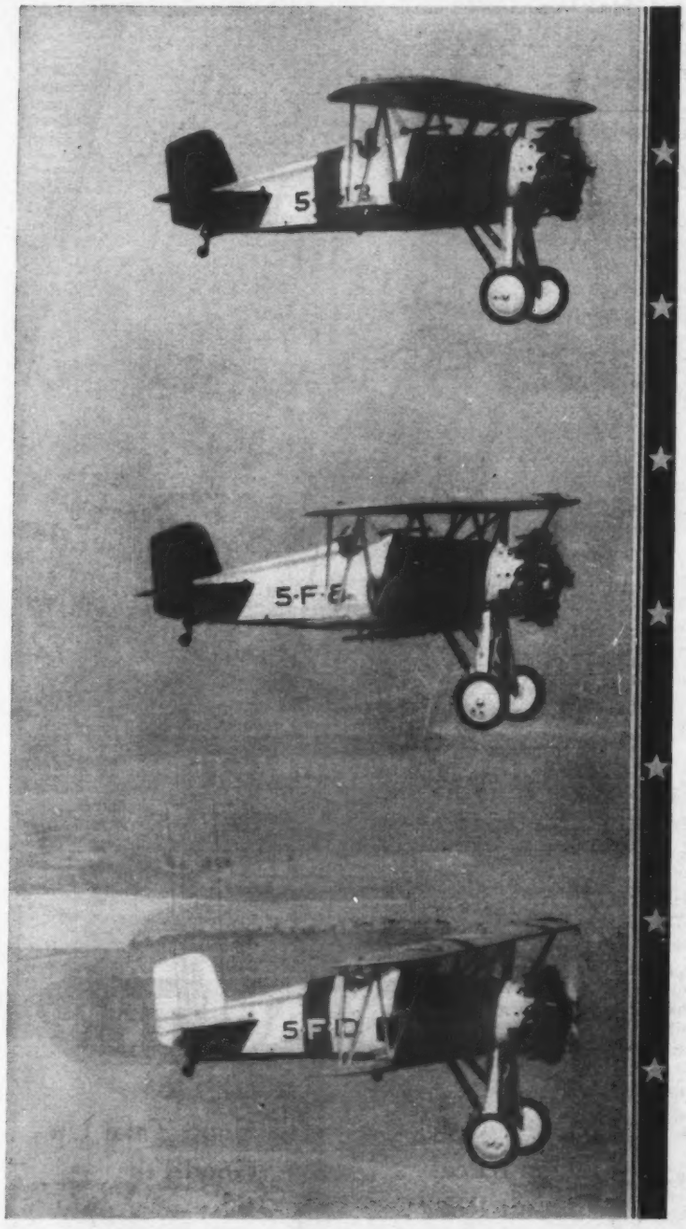

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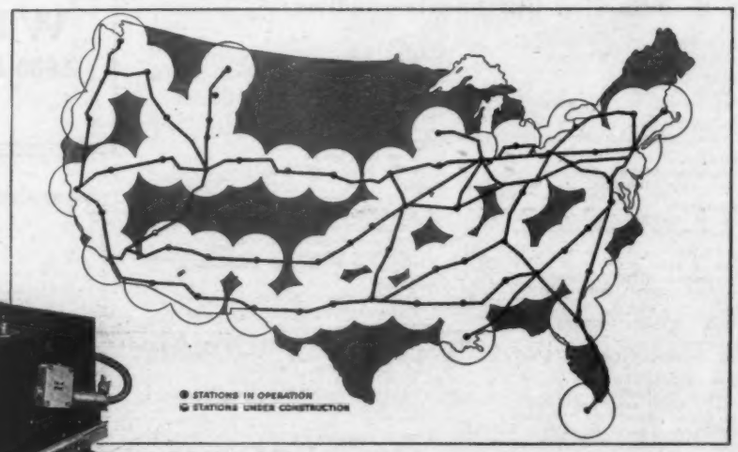

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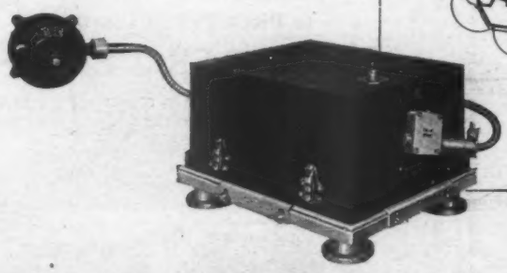

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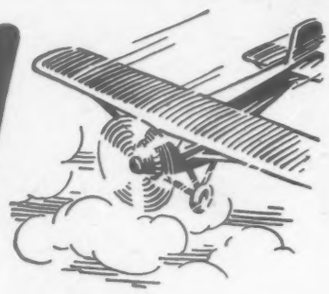

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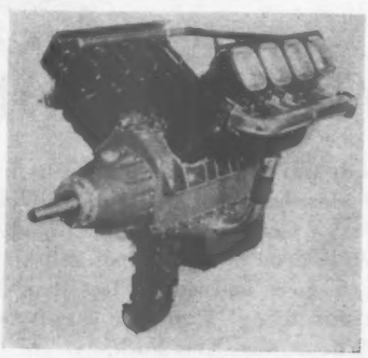

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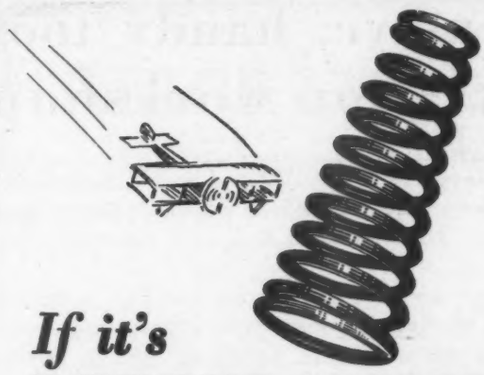

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FOR SALE: New Henderson Powered Heath Parasol. Sweet flying job. Snappy paint scheme. $400 cash or will trade for two or three place trainer. Lawrence motor, like new, $30. Would buy damaged radial job. Paul Hibbs, Parsons, Kansas.

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(Continued on page 50)

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FOR SALE

(Continued from page 48)

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WACO 9, Perfect OX-5, many extras, including air wheels, N. C. license. $800 cash. Bill Reiber, 1273 Robert St., Hillside, N. J.

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WOULD like to buy a J-5 airplane in good condition. Cabin job preferred, less motor and propeller. State condition of ship and lowest price in first letter. Geo. J. Freres, 700 Peck St., Muskegon Hts., Mich.

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AV-931

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The new Jacobs Model L-3 equipped with 2 Scintilla Magnetos.

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The Jacobs L-3 Aircraft engine —a new model entering the low horse-power field—is equipped, like all its predecessors, with Scintilla Aircraft Magnetos.

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Yours sincerely,

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Guy Miller,
Chief Test Pilot.

GM:A

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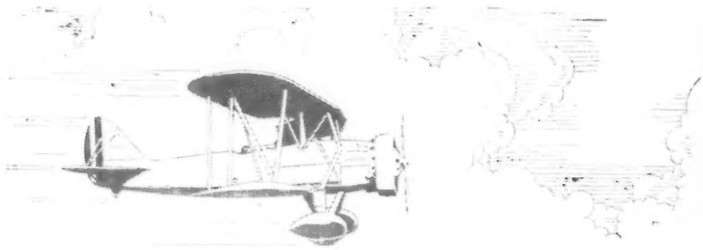
Continental Engines



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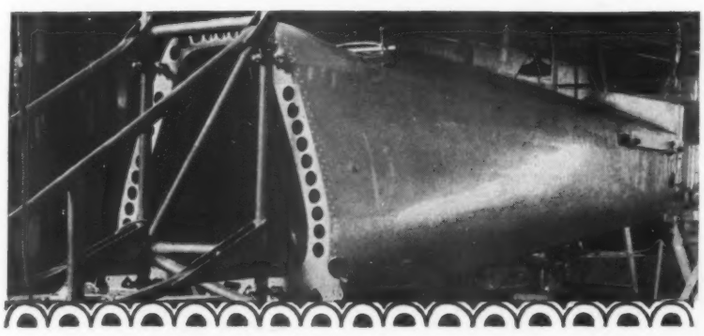

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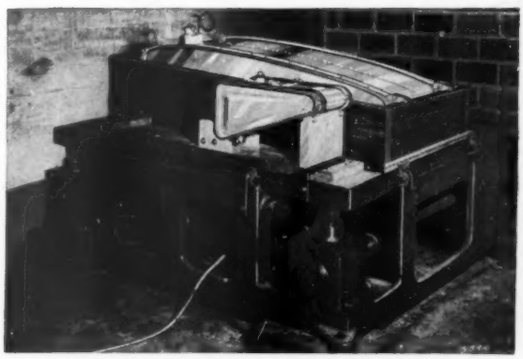

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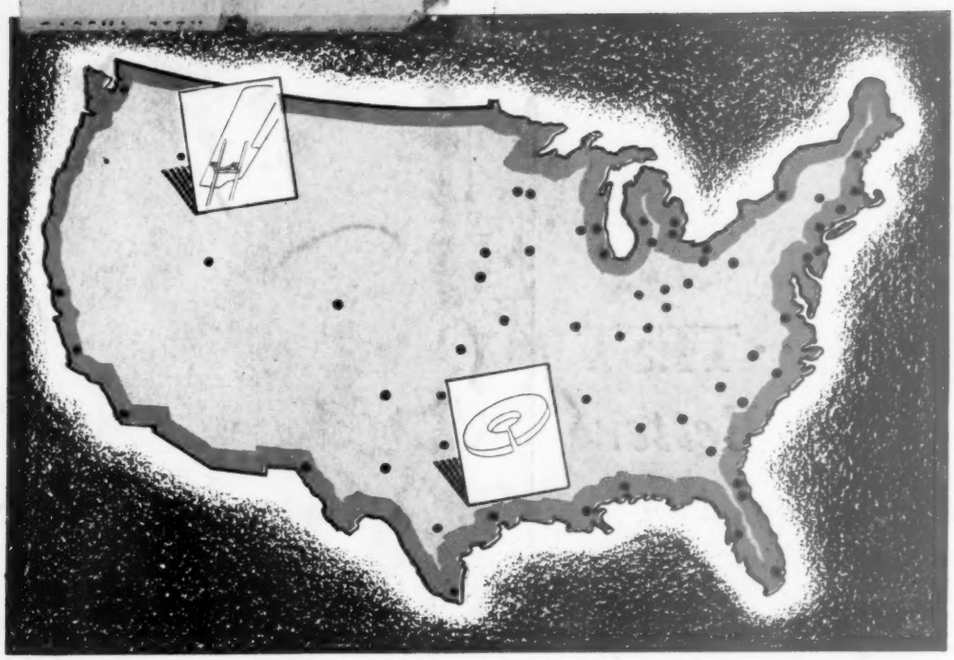

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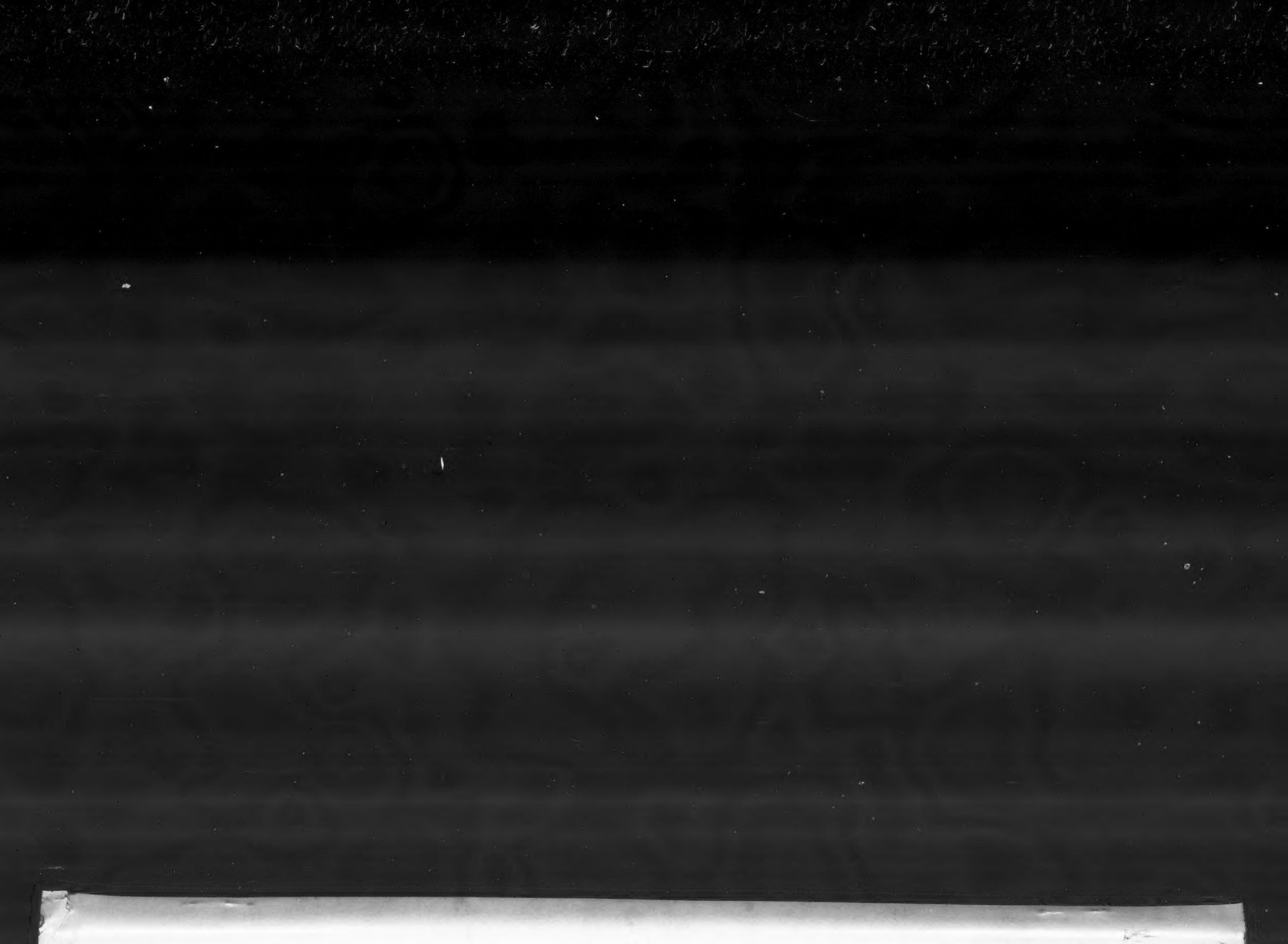
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